EVS

Exploring the River Front of MY Town

KM-132

CEE
Centre for Environment Education, Ahmedabad

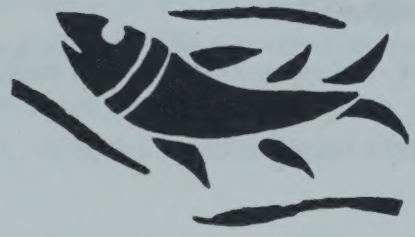
Delhi's famous Red Fort built by Shah Jehan, the Moghul emperor in the 1640s had the river Yamuna flowing just below its ramparts.

In the lower photograph, the same site shot 350 years later in the 1990s shows a busy road replacing the river, which now flows 500 metres away.

1401

Exploring the River Front of My Town

An Information cum Activity Book
for Young People



SIKSHA MITRA
(Learning Centre)
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by

Feisal Alkazi

Priti Jain

Developed by Creative Learning for Change in collaboration with Centre for Environment Education.
Produced by Centre for Environment Education, Ahmedabad, India.

CREDITS

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We are grateful to INTACH, New Delhi for partially funding the original pilot project that was carried out by a Delhi school, and which formed the basis of this book.

The draft of this manuscript was reviewed by students from schools in New Delhi, through a workshop organised in collaboration with the Teachers Centre, Ramjas School, R.K.Puram. The participating schools were : Ramjas School, R.K.Puram; Springdales School, Pusa Road; Naval Public School, Laxman Public School and Sardar Patel Vidyalaya.

We would also like to thank M.Hamza for patiently typing and retyping this manuscript many times over,and Ranjan for assisting us with the computer work. Also to Dheeraj Devgun for preparing the art works.

We are grateful to CEE's NGO Network for providing additional information. In particular we would like to thank Mrs. Therese Almeida,Madgaon; Ms. Nita Colvin, New Delhi; Dr.Vishnu Kamath, Bangalore; Ms. Shyamala Krishna, New Delhi; Dr. Anandavalli Mahadevan, Madurai; Dr.Unnikrishnan Nambeesan, Kozhikode; Mr.Ramkumar, Chennai and Mr. K.Vijayraghava, Ranebennur.

We are grateful to the entire staff of CEE South.

The book has been reviewed by Ms.Shyamala Krishna (CEE),with the editorial assistance of Ms. Nita Colvin and Meenu Ratnani.

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PREFACE

The writing and publication of this book has had a long and chequered history. The actual project work from which this text emerged was carried out in 1987 by students from Bharatiya Vidya Bhavan, and also by learners at a non-formal education centre run by Ankur Society for Alternatives in Education in New Delhi.

This project had come hot on the heels of our previous action - project that focussed on the changing urban environment near Mehrauli in Delhi. Not only had that project been very successful, but it was also developed by us into a very successful book, and a video programme that received nationwide viewing and accolades in 1986. So when support to write up the Riverfront book came from Centre for Environment Education, Ahmedabad, we were extremely excited.

At that time the CLC group consisted of the present authors Feisal Alkazi and Priti Jain, along with Martha Farrell, Jayashree Oza and Kaushalya Ramdas. We are indebted to them for help in conceptualising the original book. In particular we would like to acknowledge that the first drafts of the original chapters on Flora and Fauna, Water Management and Pollution were written by Kaushalya Ramdas, Jayashree Oza, and Martha Farrell respectively, and we are grateful to them for the same.

We are also grateful to Mr.Kartikeya Sarabhai, (Director, CEE) and Dr.M.J.Ravindranath, Programme Co-ordinator CEE, for their help and encouragement with the book. As part of completing this book, we had collaborated with CEE South and INTACH to hold two workshops with teachers in Chennai and Bangalore in 1992.

It was after these very well attended and worthwhile workshops, that Ms. Shyamala Krishna (Programme Co-ordinator , CEE) suggested that we rework the book to give it a national focus, with an additional emphasis on South Indian rivers. As CEE South had been actively connected with educational programmes on environmental studies of rivers and tanks, Shyamala felt she would be able to provide some financial support, reference material on South Indian rivers, and maybe even help find a publisher. So a second lease of life for the Riverfront book began!

Of course new material could not just be added on, and as a result we have now rewritten and reshaped the entire book.The entire exercise became both challenging and a very creative experience for the authors.

For this second version of the book, we have received invaluable support and access to materials from CEE's network of NGO's and members of CEE South.

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FOREWORD

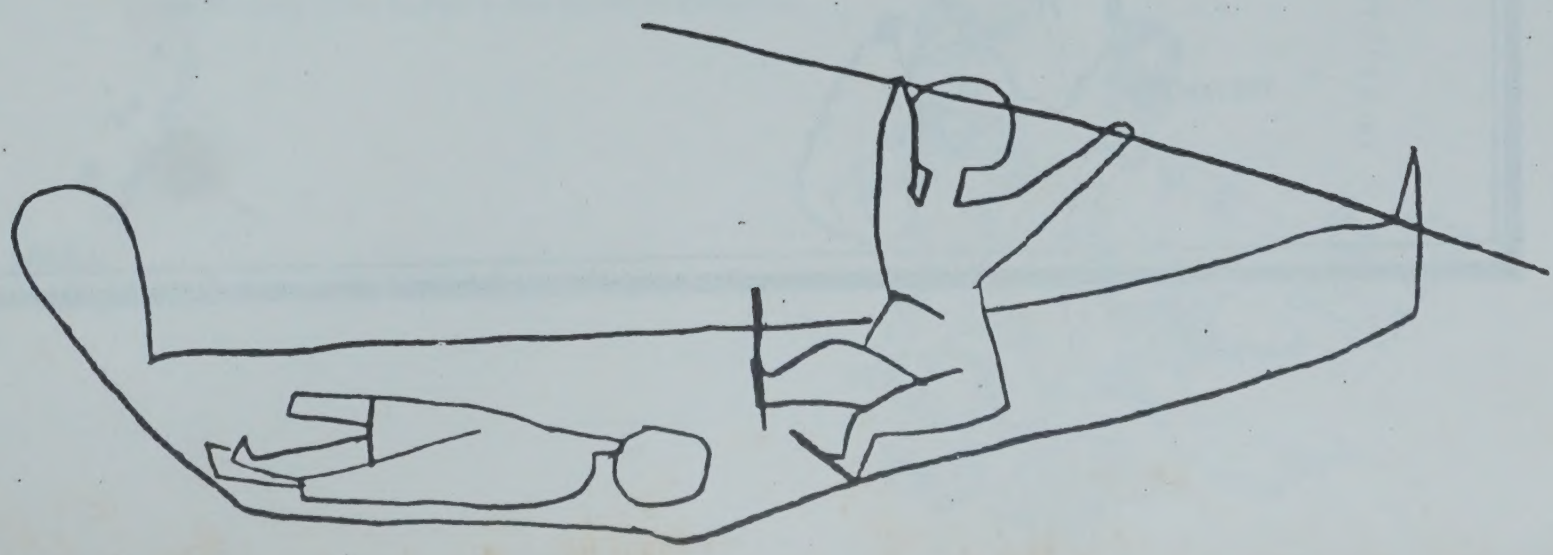
The ancient Greek philosopher Heraclitus said that one could never put one's feet in the same river twice. The saying captures the constantly changing nature of rivers. Their waters are forever moving, cascading down mountains, flowing over the plains at a snail's pace, the levels rising and falling with the seasons, on their journey to the sea.

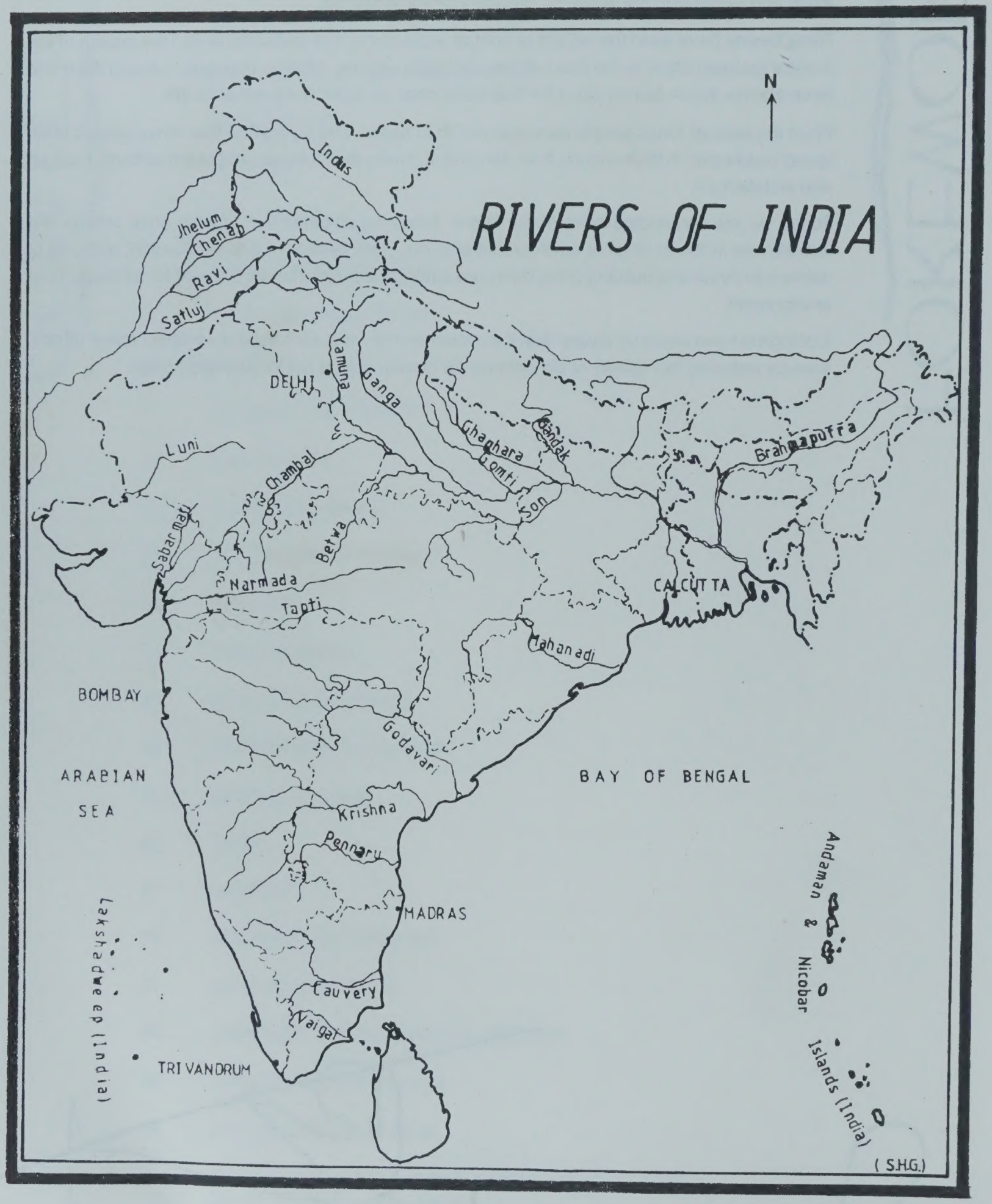
River basins have seen the origins of human settlements and civilisations and the growth of the world's greatest cities as famous cultural and trade centres. Millions of people around the world have always depended on rivers for their livelihood, as water is essential for life.

From the earliest times people have revered their rivers. The myths that they wove around them found expression in their culture: their dance and music, their folklore and oral traditions, their art and architecture.

Today we are demanding more of our rivers. Uncaring attitudes are causing great strains and imbalances in the ecological environment of rivers. Deforestation, industrialisation, disposal of waste into rivers and building of big dams are among the major causes of threat to the fragile river environment.

Ecologists have made us aware that if we interfere with one such habitat we affect many others, thereby reducing the 'quality of life' not only for human beings but for all living things.




RIVERS OF INDIA
N
Indus
Jhelum
Chenab
Ravi
Satluj
DELHI
Yamuna
Ganga
Ghaghara
Gomti
Gandak
Son
Brahmaputra
Luni
Chambal
Sabarmati
Betwa
Narmada
Tapti
CALCUTTA
Mahanadi
BOMBAY
Godavari
ARABIAN
SEA
BAY OF BENGAL
Krishna
Pennaru
MADRAS
Cauvery
Vaigai
TRIVANDRUM
Laksha dweep (India)
Andaman & Nicobar Islands (India)
(S.H.G.)

INTRODUCTION

A central concern of educationists today is how best they can equip the child with skills appropriate for a rapidly changing world. The teacher often wonders at the relevance of teaching "facts" from a text book, when these "facts" are constantly being challenged by the latest information. Rather than making children repositories of information, it is more important to improve their skills in areas such as creative thinking, developing multiple solutions to problems, exercising informed judgement, learning how to acquire and evaluate information and how to work well with people from diverse backgrounds. Unfortunately, most schools today cannot need these needs, as they are still very "traditional" in their outlook.

As a result the child is kept in a protective cocoon both at home and in school. Trapped within the four walls of the school, six hours a day, the child encounters in his/her classmates people more like him/her, than different. He/she studies with the same group for twelve years, learns about life through a textbook and rarely steps out of the school. Language learning is always the proper way to speak, not the way language is actually spoken.

The child does not really experience or experiment with science, he neatly writes down predetermined experiments in practical notebooks. History becomes a long list of boring dates, not a living continuum.

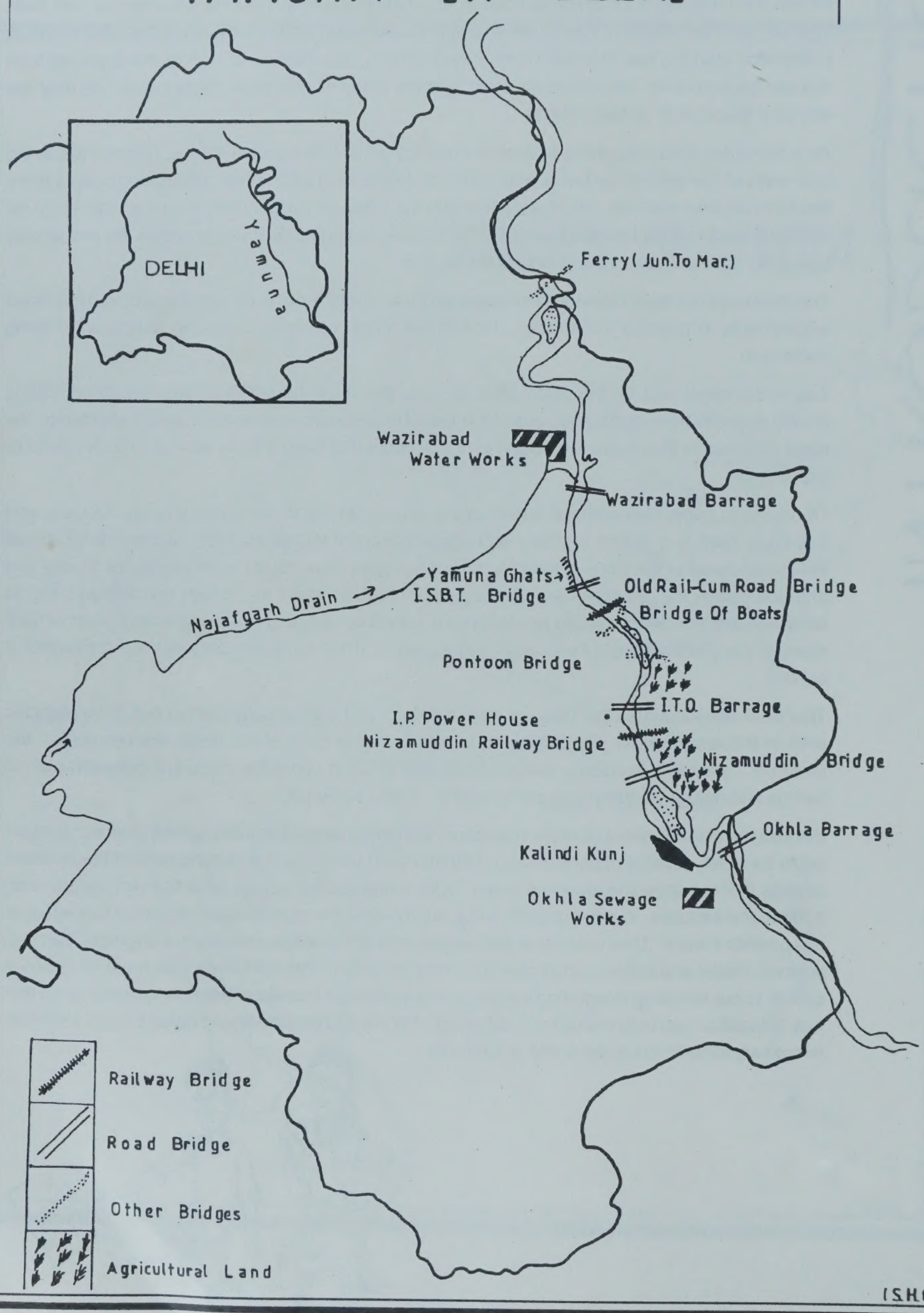
And in the same way, for the urban child of today, the 'environment' is an alien world consisting mainly of 'pretty trees and tigers'. How he is linked to the entire environment, and is affected by the rapid changes in the macro-environment is a concept that he/she finds difficult to understand or experience.

Of course in certain educational institutions, a change in this thinking has already occured, and this book itself is a record of many of these educational initiatives. Most of these educational initiatives come in the form of learning through project work. Such work integrates theory and practice, fosters the group process and helps the child to integrate the various specialised subjects he/she learns into an integrated whole. Such a 'hands on' learning experience can therefore fulfill many of the goals set out in the opening paragraph, and that too within the walls of a conventional school.

This book demonstrates the 'how', of such a project that was actually carried out, in the specific area of the environment. By picking an essential part of most of our urban environments - the riverfront - we have devised a series of activities to bring home the close link between human beings and nature, to the young person in the 12 plus age group.

But such an activity cannot be done in isolation. We firmly believe that every school must consciously seize such educational opportunities to help the child understand and comprehend the massive change that is happening around him/her. Such a process cannot but be at the very centre of an educational process. We do not believe that such issues are co-curricular, or can be tucked away in 6 periods a week. They must be at the nerve centre of the entire curriculum. Language learning, science, maths and history can all play their role in this task. This will bring a truly multi-disciplinary quality to our learning, integrating it instead of separating it into water tight compartments. In this way 'education' can truly live up to its definition - 'to care and to nurture' and equip the child with the necessary tools to live in the world of tomorrow.

YAMUNA IN DELHI



BACKGROUND

The main objective of the actual project on which this book is based, was to create an awareness and sensitivity among the participants on the varied issues related to a riverfront environment. This became all the more fascinating by providing the students a choice of topics/activities based on his/her own interest; thereby encouraging maximum participation. The second aim was to encourage creativity in educational work, especially in the presentation of project reports. While there is no doubt that students expand their awareness of several issues, even more important is **how** they get there - i.e. the process involved, for this is what sets such programmes apart from the formal classroom learning and makes it a truly educational process : one of exploration, discovery and growth. In short the entire process is an exciting example of experiential learning.

Ankur an NGO in Delhi supervised the implementation of the programme in the Bharatiya Vidya Bhavan School in New Delhi, for the students of Class-XI. The project formed part of the SUPW Socially Useful and Productive Work (a compulsory part of the syllabus) and therefore found a place on the regular time-table. It included many Saturday mornings that were utilised for field visits.

The project lasted for five months (August 1987 - January 1988) of the school year. Besides field visits, observation walks and talks with resource persons, the following activities were also undertaken to form part of the educational methodology:

Slide shows

Discussions

Role playing

Art-based activities

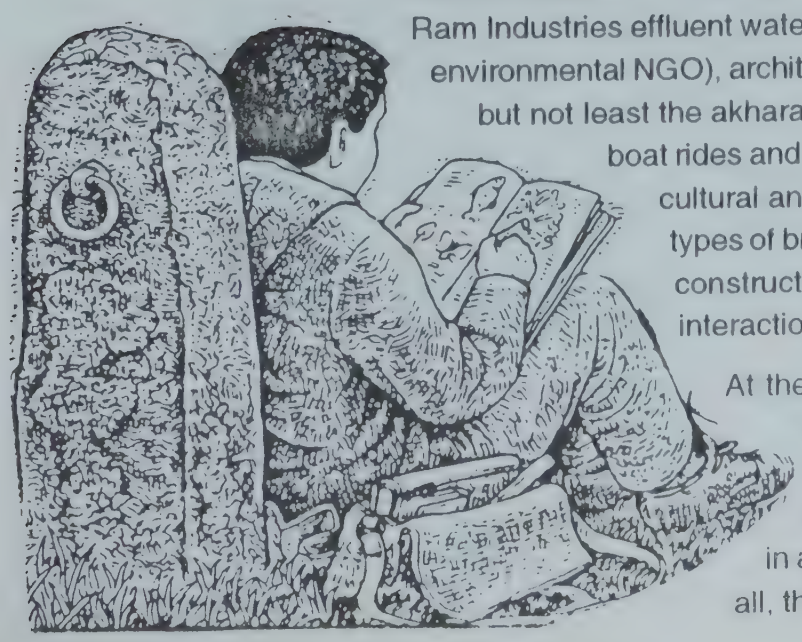
Interviews/surveys

Report writing/media articles

Visits to the flood forecasting and computer rooms of the Central Water Commission.

The environment study of the riverfront was multidisciplinary, it brought together a variety of subjects such as geography, history, sociology, environmental studies and biology. The activities were devised to co-relate several facts and issues concerning the riverfront. The past and the present history; social and economic issues; pollution, the water systems and the city's water supply; cultural traditions including oral literature and folklore.... Other areas of interest that evolved during the programme were : a comparison of occupations and housing along the river front, including contemporary town planning for this area, and ideas on water resource management.

The student group (made up of 20 students), explored all possible thematic areas through wide ranging educational activities and regular field visits. Ankur with INTACH's assistance helped arrange meetings with many resource persons/centres, such as Gandhi Peace Foundation, Centre for Science and Environment, Central Board for the Prevention and Control of Water Pollution, Central Water Commission, Delhi Water Works, Wazirpur, Wazirpur Industrial Area, Shri Ram Industries effluent water treatment plant, the Najafgarh nallah, Kalpavariksh (an environmental NGO), architect Romi Khosla, retired town planner Syed Shafi and last but not least the akhara on the banks of the River Yamuna which organised our boat rides and enabled the children to see life on the river bank, in all its cultural and social diversity. The students also studied the different types of bridges spanning the Yamuna, including the new one under construction at the time. All this was achieved through direct interaction between the students and the resource persons.



At the end of the project, the students' work and their actual involvement in evolving the entire process helped us realise the aim of interaction between curriculum/syllabus requirements and co-curriculum non-formal supplements in an imaginative, meaningful and participatory way. Above all, the students were exposed to an aspect of reality in their

immediate urban environment that is generally ignored, and which therefore does not enter their thinking, or have any priority in their growth process. More details on the events of the actual projects are given in the essay that follows.

Ankur also introduced 'The River Front of My Town' at its non-formal education centre in Gautampuri, an urban slum located on the banks of the River Yamuna, behind I.T.O. An Ankur worker was specially delegated to carry out this project. This involved taking extra classes, twice a week with these socially deprived children, after their regular non-formal education centre work.

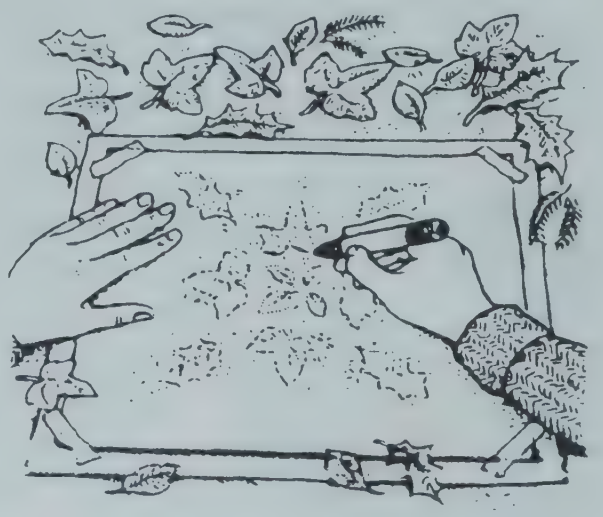
In this basti, as the children lived by the river, most of their needs were being met by the river. Therefore the entire thematic approach to the project was given a positive concept : how does the child react to the river, and what benefits and what drawbacks does he experience living on the river front?

The children belonged to the age group 6 - 12 years and could not read or write fluently. Hence, most of the work was designed around 'doing' activities - talking/story-telling sessions, visual demonstrations and field visits, modelling and drawing, the last two of which proved to be great favourites. The thematic areas of history and geography were simplified for them. The historical aspect was covered by actual visits to the Red Fort, Feroze Shah Kotla and Purana Quila. The story of the Yamuna was unfolded through picture charts, under a tree by the riverside, as a precursor to the programme, and was a great success.

The geographical dimension was revealed through a series of charts depicting the origin of the river in the mountains and its journey down to the plains. The children were involved in the actual construction of a plaster of paris model of the river's course, making the learning process self-explanatory.

It was in this manner that all the relevant study areas : pollution, water resources and water-borne diseases were simplified and activities were designed for the children to learn by participating. The children conducted interviews in their homes and with other adults in the basti, touching on aspects such as migration, occupation, living by the river.... these interviews were taped with the help of the Ankur staff.

Agriculture plays an important part in the lives of families living on the bund. River-bed agriculture and water being pumped from the river were subjects included in the project. Besides talking to the 'farmers' of this basti and understanding the mechanics of pumping water, they learnt the names of the cereals and vegetables being grown and their benefits. They also made a 'herbarium' of a variety of leaves in their note books. The children revealed various aspects of the social life by 'talking' into a tape, taking note of all that they saw and felt. They made a model of their basti which included the I.T.O. bridge, the river, their fields and their huts and the Rajghat power station. Drawing was a favourite activity done in all earnestness with a group of five sharing the same crayon.



A resource group at Ankur planned weekly activities and areas to be covered. This led to a systematic approach which took into account all details including answering questions that arose in the community regarding whether such a learning process was worthwhile. It was a novel experiment in experiential learning, and the enthusiastic response of the children was one that had to be seen to be believed.

AN ESSAY

YAMUNA RIVER FRONT PROJECT

On completion of their work on this project, two students from New Delhi wrote the following article, that was published in the INTACH newsletter No.12 of Jan-June 1988.

Today we are going on a funny sort of picnic - there are twenty of us going in a boat down the Yamuna at 7.30 in the morning! We are all very excited for we are repeating a historic journey that thousands of people and their conquerors have made down this same river.

But I am going off at a tangent. Let me first explain how the trip originated. It is part of our new S.U.P.W project in which we will study the Riverfront of the Yamuna. A resource person of a voluntary educational agency came to introduce the project to us. Our 'Environment Study Group' is going to spend six months exploring a web of different but inter-related topics under which our river can be studied. Exactly how are we to do this? Our resource person said that we were to find the answers to our questions ourselves. We will be given no set syllabus and no marks. We will plan out the whole process ourselves with the help of the resource people from the agency and our teacher, and learn for ourselves.

In our first discussion we felt we could study the geographical features of the river, its origin and course, and the abundance of flora and fauna in the river and along its banks. We could look at the history and culture of the people who lived there, their social life and even other river settlements of India. Another aspect would be to study the effects of water pollution on the river, the fields, of planning and water management and even plan an ideal river front of the future. In short, our explorations and study covered the entire environment of the Riverfront of My Town!

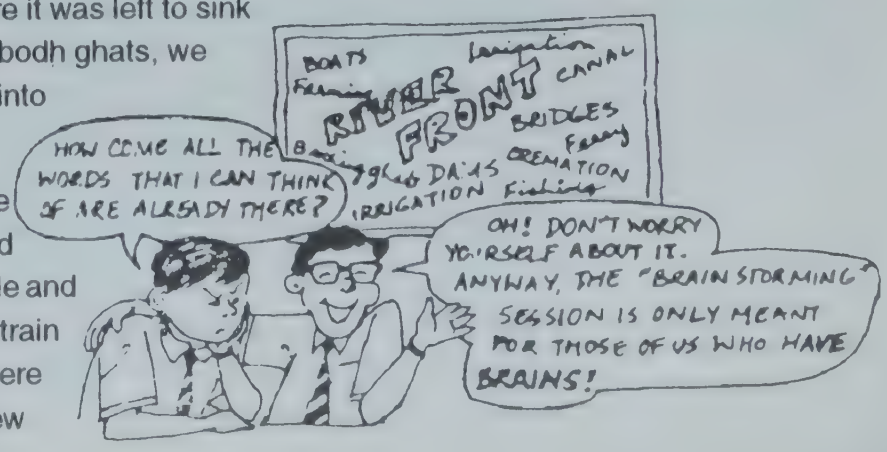
We decided that the best way of finding out what we wanted to concentrate on would be to actually go down the river. And I will share with you some of my experiences of studying the Yamuna.

The first thing that struck me about the Yamuna was that its water wasn't blue! It was rather a kind of grey black colour. Nor was there any strong current or flow in the river, and the oars of our boat soon developed a grayish coating of muck. We could see very few fish or water birds, and the reason we found was that pollution had driven them away. The few signs of animals life we did see were the carcasses of dead buffaloes floating in the water. They smelt awful.

Our boatman, who comes from an old 'akhara' beside the river, told us that the major sources of pollution are the seventeen 'nullahs' that empty all of Delhi's sewage and other urban waste straight into the river. A lot of the water is stopped before it enters Delhi at the Wazirabad Barrage. When we walked across it we found that upstream the river was clear, blue and my God, plenty of it! But downstream, toward Delhi there was no river, only slush water from the nullahs with buffalo carcasses floating in it. The water was oily and grey and this formed the Yamuna of Delhi!

Later we were surprised to see so many steps that formed the ghats along the river, they stretched for nearly a mile! The buildings along the ghats, which at one time must have formed a cultural entity, were now broken, dilapidated, uncared for and full of garbage. We found it contradictory and strange to still see so many bathers on the ghats. We are told that they were migrant labourers who have no other access to bathing facilities in the city. Our boat wove its way through fields of unchecked hyacinth growth that choked the river.

The most poignant sight of all was the water burial of a child. A boat carried its little body wrapped in white into the middle of the river, where it was left to sink to the bottom. In contrast, at the Nigambodh ghats, we saw a man throwing tubs full of ashes into the river with total unconcern.



We also had an unusual view of the bridges - from the underside! We could look up at the tremendous bustle of people and traffic that cross the river at all hours. A train thundered over the iron bridge while we were right below it. We also saw a huge new

bridge under construction, an awesome sight that 'gheraoed' so much land and water. The other extreme was the boat bridge that has spanned the river from Mughal times and is still going strong. The boats are strung right across the river with iron planks and gravel put on them - this forms the road.

Another relic of the past were the little old ladies who sit by the ghats to sell 'kumkum' and oil to the bathers. Once they were patronized by the noble ladies from Shahjahanabad, but today business is not good.

Then we went to the banks to meet some of the people whose lives are touched by the river every day. A fascinating place was the ancient 'akahara' that our boatman came from. Until independence it had provided for the populace around the river the kind of institutional arrangement that a sports club provides today. A rigorous daily schedule and strict discipline was maintained to train young people in wrestling and as lifeguards for the river.

Beside the iron bridge was a virtually self sufficient slum colony. It was as congested and dirty as slums everywhere. The people make their living as autorickshaw drivers, vegetable vendors, sellers of 'cholle bhature', dhobis and rag-washers along with scores of small-scale activities from within the shanty houses. The slum developed around thirty-five years ago, long before the highrise buildings that surround I.T.O today, came up. They grow their own vegetables on the river bed, and even have a doctor's clinic and other services in the midst of their huts.

From there we went to the 'basti' of Gautampuri, our last area of study about the social life around the river. We interviewed the adults and went to a non-formal education centre also run by the agency, where young children from the slums were studying the river, under the guidance of a resource person. They did not know how to read and write, so the approach they followed was very different from ours. They learnt about the geography of the river and their own basti through charts and models; about the vegetation by collecting a herbarium, and tried their hand to learn simple methods to purify water in their homes. They seemed to be enjoying themselves a great deal, for they were doing small projects that helped them understand more about the river by which they lived.

Back in our classroom, we read through mountains of stuff that our resource person had helped us collect. We were amazed at how much relevant material has appeared in the media about the river. This was supported by two slide shows and lively discussions and debates with outside resource persons who were scientists and professionals in river and water pollution, water monitoring and water management. Then we began to interpret the information we had gathered in the form of charts, posters, collages. We wrote and performed role plays and skits on our theme of study during our S.U.P.W periods.

In addition we learnt a lot from the various people who came to our school or whom we went to meet. We met ecologists and environmentalists to understand the nature and extent of pollution in the river. I particularly remember an architect who had drawn up a detailed plan for the development of the river front over the next twenty years. He also stressed how important river fronts have been to mankind, and how they have been developed in various different ways all over the world throughout history. We suggested that trees be planted and playgrounds and other public facilities be provided along the bank so that the river could be preserved and people could also enjoy themselves.

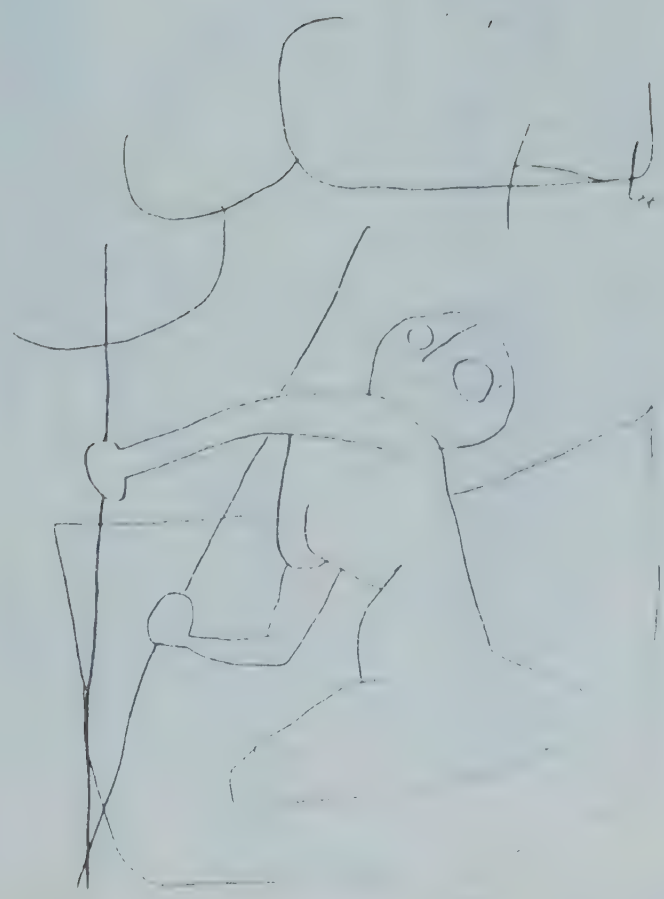
Another day we visited the Shri Ram Fertilizers plant in Najafgarh, where industrial effluent are treated to make them harmless before they enter the river. It is a very well maintained high technology plant. But unfortunately few industries follow their example and have such treatment

plants. We found the small scale industries were the major pollution hazards. Walking throught the Wazirpur industrial area we could actually see acid and water hissing and reacting as chemical waste was poured into the 'nullahs', which joined to make a network of bigger and still bigger 'nullahs'. Our city has a maze of 'nullahs' that pour lethal contents into the Yamuna.

On one of our field studies we visited the Wazirabad Water Works which provides part of Delhi's water supply. We had all read about the process of water purification in our text books, but to actually see the working of a plant was an eye-opening experience. No longer does it mean just opening my tap!

Before we began this project I had only seen the Yamuna a few times when I crossed a bridge, or as a blue streak on Delhi's road map. But actually doing a field project on it was a very involving experience, much less boring than pouring over text books in a classroom all the time. We gathered a lot of information that answered some of the questions we had thrown up. I and my friends woke up to the problems of our Yamuna.

Rivers are finely balanced ecosystems on their own, and the tinkering our elders have done with them have not left much of a river for us. Our rivers have always been important contributors to our culture and economy. In return, don't they deserve a better deal from us?



THE RIVER FRONT OF MY-TOWN

FUTURISTIC
HOW WOULD YOU PLAN THE RIVER FRONT OF YOUR TOWN

GEOGRAPHY
- ORIGIN
- COURSE OF RIVER
- FEATURES

HISTORY & CULTURE
- ARCHITECTURE
- CONSERVATION
- MONUMENTS
- ORIGIN OF SETTLEMENT
- PEOPLE ON RIVER FRONT
- RELIGION
- MUSIC, DRAMA, & LITERATURE
- MYTHOLOGY
- TRADITIONS
- FESTIVALS

FLORA & FAUNA
- FISH LIFE
- BIRD LIFE
- VEGETATION

OTHER RIVER SETTLEMENTS
COMPARISONS

STUDY OF HISTORICAL GEOGRAPHY

CONSERVATION

SOCIAL LIFE
- POPULATION
- INTER-DEPENDENCY WITH THE REST OF THE CITY
- OCCUPATION
- HOUSING ALONG RIVER FRONT

POLLUTION
- EFFECTS ON RIVER THEN AND NOW
- URBAN WASTE
- DRAINAGE
- INDUSTRY
- POLLUTANTS
- MONITORING
- ENVIRONMENT ACT

PLANNING
- EXISTING ADMINISTRATION PLAN FOR THE RIVER FRONT
- WATER MANAGEMENT
- USAGES
- DAMS
- BRIDGES
- WATER WORKS
- CITY'S WATER SUPPLY

HOW TO USE THIS BOOK

This book has been devised as an activity-cum-information book that can be used by schools and young people in any town/city with a riverfront. It has been divided into eight chapters - each concentrating on a specific topic linked to the riverfront. The main focus of each chapter is the background information that clarifies the concepts talked of in the chapter and details various activities that can be carried out. These activities are a mix of science based, language based, and art based activities. All the activities mentioned in the book have actually been carried out by school students. The activities are designed for different time- frames : some can be done in a single thirty minute period, others might take an entire term. You may want to do one complete chapter or just a single activity. It is also possible that different senior classes within a single school can take up different chapters, culminating in an inter class exchange. The entire content of this book can thus be used meaningfully.

The illustrations have been specially created so as 'to speak' for themselves and in many places they serve in lieu of a written text. They can also serve as creative guidelines for carrying out a study of a riverfront environment.

In addition, in each chapter you will find 'pages from a student's diary', a brief diary excerpt that captures some part of what was done in the original pilot project in a Delhi school. Therefore you will find that the case study of the Yamuna river appears in each chapter. Also each chapter has an example of an Indian river and of an international river. These examples serve to illustrate and highlight the subject matter of the chapter.

Between each of the eight chapters, are seven double spreads that focus more exclusively on case studies of rivers in South India. They attempt to link the material of the chapter that precede them,with the chapter that follows. For example the double spread on tanks links the concepts of 'Water Management' with that of 'History'. Many examples, activities and studies in these pages have actually been done by students and youth groups in South India.

At the very end of the book you will find four appendices. Appendix 1 gives guidelines on evaluating the students work . Appendix 2 and 3 focus on the two great rivers of our country, the Ganga and Indus. Appendix 4 details out how to actually carry out the water monitoring of a river.

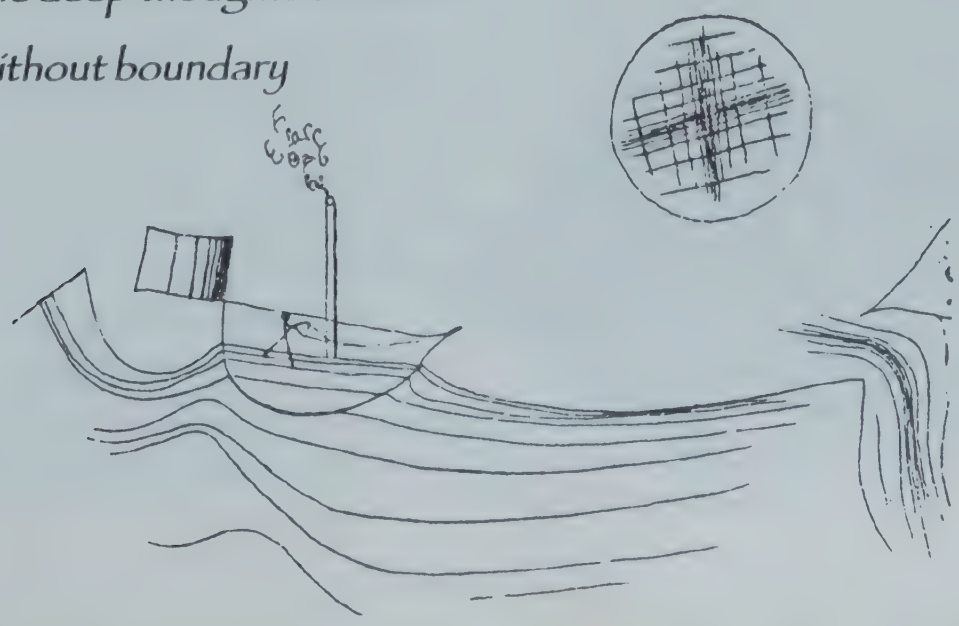
All the concepts, ideas, background studies and readings, activities, cartoons and illustrations given here can be translated, transferred and replicated to suit the specific study of a riverfront and a river located anywhere in the country.

The earth has a limit

The mountain, the sea

But the deep thoughts of men

Are without boundary



charting the course

"Be like water. Soft and limpid.
It finds its way through, over or under
any obstacle. It does not quarrel; it
simply moves on."

Lao-tzu
Founder of Taoism

How is a river formed? Where does it come from? What is its life story? These, and other questions related to geography are dealt with here. Read this in combination with the case study of the Brahmaputra given opposite, and the Cauvery given on pg 7 to gain a better understanding.

"The archetypical young river in its mountain course, uses its great velocity to gouge and tear a narrow channel for itself through obstinate rock. Here it is a racing mountain torrent, surging through narrow defiles and crashing over rapids."

Mukul Keshavan

'Rivers swollen by a mass of
turbid waters,
Rush with impetuous haste
towards the seas,
Felling trees all around on their
banks'

Kalidasa, Ritusamhara

The major portion of the rain that falls on land, soaks through the soil till it reaches a layer of impermeable rock. The water then runs along the top of this impermeable rock till it finds a way out. It may emerge from the ground as a spring which feeds a stream, and then, as the water of other streams (known as tributaries), join it, turns into a river. A river's source may also be a melting glacier (see the Brahmaputra story opposite) or it may flow out from a lake. For example, the river Nile emerges from Lake Victoria in Africa.

A river goes through various stages in its life. In its early stage it flows fast, carrying pieces of rock, large and small. These pieces of rock grind against the bottom and the sides of the river, and gradually the river becomes wider and deeper, creating a 'bed' for itself. The process by which rivers wear away at rocks is known as erosion.

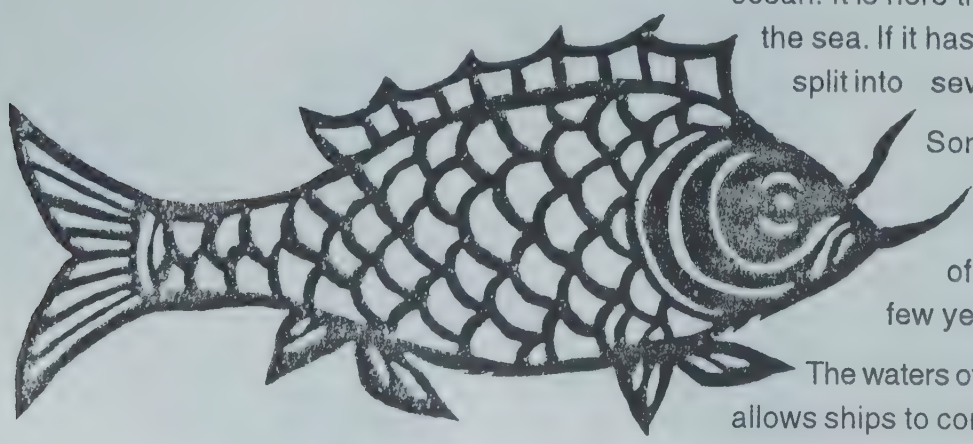
Such a river becomes perennial when it cuts the earth deeply enough to be fed either by groundwater or when it has an unlimited source.

As a youthful river experiences a sudden change in level on the earth's surface, water tumbles over the edge and forms a waterfall. The hollow formed at the bottom of a waterfall is known as a plunge pool.

Finally the river moves out from the hills and mountains, and into the plains. It is now in its mature stage. Flowing over land that is not steep, the river begins to slow its pace. Many tributaries join it to make it a large body of water. Since it is flowing slowly, it cannot carry rocks any longer, but it does continue carrying a sediment of sand, mud and small stones. The river now bends or meanders in its path. An increase in the amount of water in the river, due to heavy rains or melting snows upstream, results in the river flooding and overflowing its banks.

When the water of the floods in the river recede in the plain, they leave behind a layer of fine, rich mud.

The end of the journey comes when a river reaches its mouth: the sea or ocean. It is here that the freshwater of the river meets the saline water of the sea. If it has a wide mouth, we call it an estuary. The river may also split into several channels when it reaches the sea, forming a delta.



Some rivers carry vast quantities of sand and mud that they dump on the ocean floor near the estuary. For example the Ganga and Brahmaputra deposit 2000 million tonnes of silt every year, near their delta. Geographers feel in a few years this will form an island by itself!

The waters of other rivers dig a deep channel into the sea. This channel allows ships to come up the river and unload their cargo at a dock located upstream.

THE BRAHMAPUTRA

One of the world's greatest rivers, the Brahmaputra begins as a glacial trickle in Western Tibet and sweeps 1800 km to the Bay of Bengal. Brahmaputra means the son of Brahma, the Hindu god of creation. The river has many avatars, changing its name and nature with the myriad cultures of China, India and Bangladesh. Till today no one is known to have travelled the entire length of the river.

The Brahmaputra (or 'Zangbo' or 'the river' as it is known here) originates in Tibet. Herds of yak and sheep, black wool tents and solitary horseman, Tibetan eagles and giant Himalayan ravens, fox and antelope inhabit the plateau of Tibet. The river is born 100 km. south-east of the famous Mount Kailash - considered the centre of the universe by Hindus, Buddhists and Jains. Here, at a height of 5040 m. the river starts life as a mere trickle from a glacier. Most Tibetans live along the Yarhung Zangbo - as it is the only source of irrigation in this land kept dry by the rain blocking Himalayas to the south. The river is placid, has clean water and collects a number of tributaries along the way. It has a navigable stretch of 600 km in Tibet, on which merchants have been plying their locally made boats for hundreds of years.

The river narrows at Pei, falling in a series of water-falls, a phenomenal 2100 m. in 40 km.

The Brahmaputra then emerges from the Himalayan foothills, and rushes into Arunachal Pradesh in India. Here it is locally known as Dihang. The tribal group of Adi, animists who sacrifice animals and consider the river a deity, live on its banks. Other than harvesting, they hunt birds, rats, boars, monkeys and deer to supplement their diet. The river then enters Assam where it is joined by two eastern rivers - the Dibang and the Lohit. These three important streams unite to form the Brahmaputra of the plains.

The Brahmaputra is the life-line of the Assam valley. It offers rich alluvial fields for agriculture and has a wealth of villages dotting the banks all along its course. The river is steeped in the history, folk-lore, and culture of the people who live in these villages and towns.

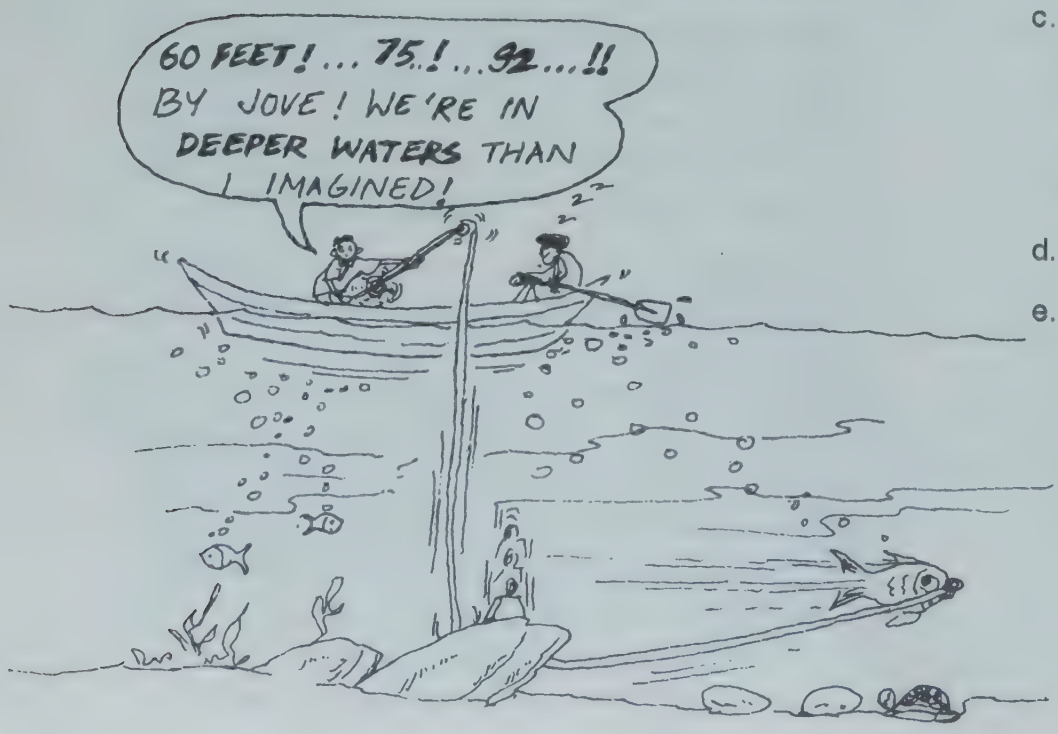
During its journey on Indian soil it collects 33 main tributaries. While passing through the Assam valley the river meanders a lot. At some places the range is more than 15 km wide. This results in the forming of sand-banks and many river islands. The world's largest river island, Majuli is found here and it is 1250 sq km wide. (See the box item 'River dwellers of Assam' on page 61 too) Every year between June and September, the heavy monsoons and the melting Himalayan snows raise the water level in the river, and result in a flooding of its banks and the surrounding low lying areas. This

flooding is even worse now, as the fast flowing river carries 200 m tonnes of silt a day. The roaring waters cause severe erosion when they recede, creating new low lying areas. Though this annual rise in water level is natural, increasing deforestation in this area is largely responsible for the terrible floods every year.

When it enters Bangladesh, the Brahmaputra joins the eastern most part of another great river of India : the Ganga. Together known as the Padma, they move on to empty out in the Bay of Bengal. Other rivers like the Meghna meet the Padma and this great waterbody splits into many distributaries creating the world's largest delta, near Chittagong.

The Brahmaputra is fast losing its reputation as a great highway. Gone is the commercial activity of pre-independence days, when large steamers carried cargoes of jute, timber, tea and rice. Today, accumulated deposits of silt and shifting sand banks, along with the river's frequent shifting course makes navigation by larger vessels difficult. Opening up of the region for 'development' has resulted in the cutting of forests for tea estates, the exploitation of oil, the commercial consumption of minerals, rubber plantations, local plywood and pulp factories, settlements and slums. The unscientific methods used and a lack of planning are resulting in irreversible environmental damage.

The Brahmaputra valley was once known for its rich heritage of flora and fauna. Today, a number of species have silently disappeared due to the change in the delicate ecological balance. The stillness of the remaining tropical rain forest through which this mighty river runs, is now broken by the constant sound of an axe.



Activity

A GEOGRAPHICAL EXPLORATION BY BOAT

Have you ever thought of investigating the river that flows through your town? It must contain many of the geographical features that are common to all rivers, and a few that are unique to itself.

Obviously it would be difficult to study the entire length of the river from its source to where it meets the sea, but it would be worth the effort to at least study its course through your town... and what better way to begin than with a boat ride?

Plan for a half day long outing on a boat down the river. You would probably have to arrange this in advance with a sailing club or along with a local boatman. Use this ride to look for and find out more about the following:

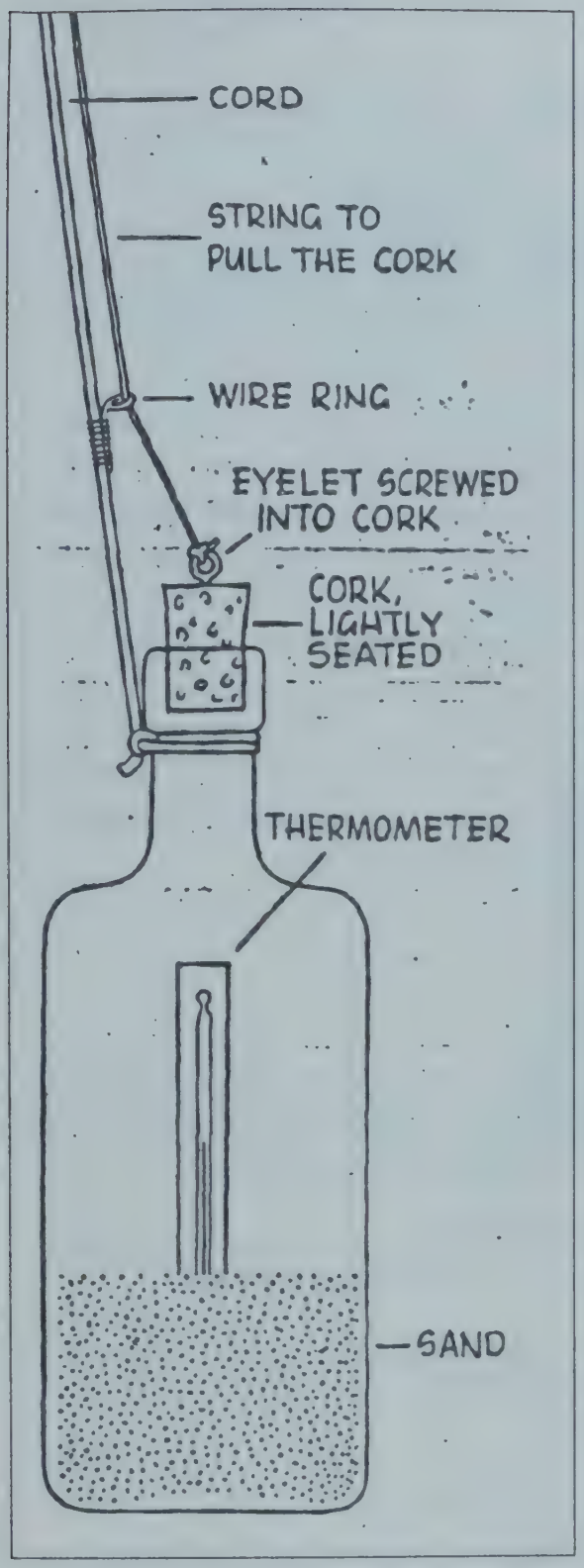
a. Has the course of the river changed at all over a period of time ? Does the river flow today where it did 100 years ago ? If it has changed its course, what could the reasons be ? Consult individuals, maps or books when you get back to school for more information.

b. Take a guess at what the depth of the river is at three different points... Can the boatman help you with a guess estimate ? Is there any other way of ascertaining the depth ? Experiment with a length of string to which a stone has been attached. Have you heard of the secchi disk ? And, how useful it is in measuring the depth of a river or a lake. Refer to water quality monitoring in schools, in the teacher's manual given at the end of this book.

c. Did you know that the temperature of water varies at various depths ? Think of how you would test this during your boat ride. For one possible way of doing so, look at the experiment suggested on the following page.

d. Notice the river bank's features. Is it rocky or sandy?

e. What kind of vegetation is found on the banks and in the water ? One plant that you will probably see growing on the surface of the water is the water hyacinth. Find out from talking to people and from books, what these plants do.



f. Examine the fauna : bird, animal and insect life that lives in the water and on the banks. What are the connections between the different types of life here ? Can you develop a food chain linking these together? For further details see pg 10. Is your river visited by migratory birds? Have any birds stopped visiting your river? What could be the possible reasons for this?

g. List out the varied types of occupations being carried out on the river and its banks. From fishing to ferrying to agriculture... See pg 59.

h. Look in detail at how people live on the river bank, using it for bathing and washing, building their huts out of reeds and grasses that grow there. What happens to them when the river floods or when the water recedes in the hot summer months? Spend time after your boat ride interviewing some of these residents.

i. Are there any islands in the stretch of river that you are visiting ? Do their sides gradually slope till they reach the river bed, or do the sides have a sharp vertical drop to the river bed ? Do these islands get submerged in any season? How can you check this out?

MEASURE WATER TEMPERATURE AT VARIOUS DEPTHS

Make the bottle device and use as illustrated here. Lower the bottle to the desired depth. Pull the cork. Allow time for the bottle to fill with water and for the temperature inside the bottle to stabilize. Then raise the bottle quickly, and read the thermometer at once. Write down the temperature on a piece of card. Repeat the process at various depths.

Water is often layered according to temperature. This has a great influence on the ecology of the water. But when a factory discharges hot fluids into a river, lake or harbour, or when surface pollution such as oil pollution occurs, then nature's water temperature arrangements are upset. Both plant and animal inhabitants are affected.

When measuring water temperature at various depths with this bottle device, mark the card with black points at 30cm intervals.

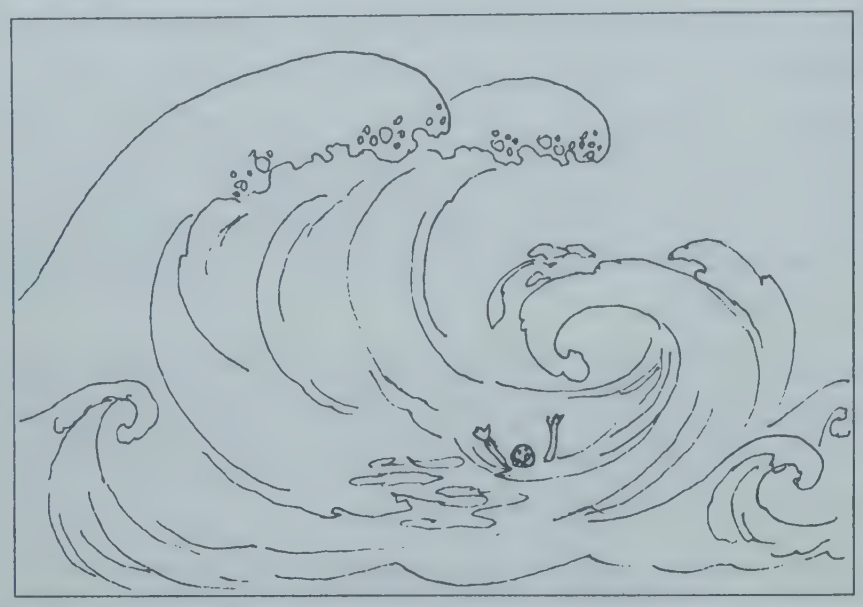
The Yangtze

Among the most important rivers in the world is the 5520 km. long Yangtze, China's principal commercial river. Its length and width have made it possible for steam, junk (a flat bottomed boat, usually carrying a variety of cargo and passengers as well) and fishing boats to navigate it over the centuries. As a result the Yangtze served as a highway for the collection and distribution of half of China's commerce. Great towns and centres of trade developed on its banks.

The Yangtze river flows in a south-eastern direction through narrow valleys separated from one another by lofty ridges. It enters into mainland China through many bends and loops. The river then flows through the famous red basin of Szechuan and it is here that the Yangtze receives many tributaries through parallel valleys. During its course, the Yangtze forms into dangerous rapids and hoop-bends.

In the winter months, when the water level drops, many Chinese squat at its edge and pan for gold dust.

WHY FLOODS ?



Forests help prevent floods in many ways. When it rains, the soil around the roots of vegetation soak in water. As the roots of trees hold the soil together, less water "runs off" the forest land. As a result there is very little loss of top soil. As the soil is held firm by vegetation with big trees, there is much less soil erosion and hardly any landslides.

Soil erosion and landslides caused by cutting trees and careless road building in the hilly regions, can result in siltation and blockages in the water flow of the river. Silted river beds raise the water levels of a river so that it eventually overflows its banks, in this way making the river more and more "flood prone". Blockages by landslides in the river creates a vast collection of water. When this "blocked up" water overflows with great speed and force, it causes floods. In the Himalayan mountain ranges, major floods are often caused by landslides in areas where trees have been felled.

Activity

SWIRLING WATERS, ROARING RIVERS

Divide the entire group into three smaller groups. Let each one of these groups carry out one set of the activities given below. Then get together and share your experiences. Look at the note given alongside to understand more about floods.

GROUP A

Music is an effective "trigger" to create different emotions and moods. With a little searching you will be able to find a piece of music that gives you the feeling of a river in flood. Tape it on an audio cassette and take it to school. Find an empty room/hall, and listen to this music as a group with your eyes closed. Let each one of you imagine the feelings of a person who is suddenly surrounded by the swirling waters of a flood. Some of you may feel scared and threatened, others may feel anger... or even depression. After the music is over, let each one write a short piece - either in prose or as a poem, about the experience. Then everybody can read aloud his/her piece to the entire group.

GROUP B

Working in groups of three, devise posters about the causes of floods, using a maximum of visuals and a minimum of words.

GROUP C

Interview older people of your town and read local newspapers published over the last five years, to study the pattern of floods of the river of your town.

Investigate the following:

How often has your river flooded/dried up?

What effect has this had on:
Displacement of people.
Loss of property.
Occurrence of deaths.
Rehabilitation programmes.

With this information write an article for your school magazine.

Activity

MENTAL MAPS

An effective technique before starting work on such a project is getting all the members of your group to draw out their own individual maps of the river front as they remember it, from memory. It does not matter if what is depicted is incorrect, as it depicts 'where' the group members are, before they begin work on the project.

This may prove to be a humorous activity, when you later compare these mental maps with actual maps of the river.

PAGES FROM A STUDENTS DIARY

18th July

Fantastic new project ! Riverfront and environment.
Great ! Good fun - promises lots of outdoor activity.

2nd August

To get to the banks of the Yamuna we took the Ring Road. It was hard to imagine that this busy road was actually the Yamuna river itself, when Shahjahan built the Red Fort. The river used to touch the fort - today the road touches it! I wouldn't believe it until the teacher brought some quaint paintings, of the river touching the walls of the Red Fort and the Ferozshah Kotla. Interesting ! They were done by British travellers.

The motor boat was waiting at the steps of the Akhara Ghats. Two wrestlers were our guides and boatmen. "Akhara" ? we had to ask. They were traditional wrestling schools of the 17th century, that are still flourishing even today.

During our boat ride, the Yamuna was full of water (which is normally not the case). The banks were wide muddy farm beds especially on the eastern bank. Our boatman told us that the melons that we eat in Delhi come from this river bed. So much silt along these banks. Is this "new mud" making the banks wider? Can this be a reason for the Yamuna to change course again ? If that happens it will be terrible - for today we have houses and people on both sides of the river.

The Western bank is very different - it is higher, rougher and not so shallow. Traditionally the city always got built on this side. As we neared the ancient boat bridge, the boatman told us of an old legend - about how the wheat and vegetables used to be transported from the fertile low lying fields on the Eastern banks to feed the people of Shahjahanabad (Old Delhi).

Imagine this very rickety bridge is still used and is still going strong. Actually I must verify this story. Some people just love to spin yarns!

THE CAUVERY

What the Ganga is to North India, the Cauvery is to the South. As the Cauvery is one of the most sacred and significant rivers of South India, it is often referred to as 'Dakshin Ganga'. The eighth longest river in India (800 km in length), the Cauvery originates from a spring at Talacauvery in the Western Ghats in Coorg district, from where it flows south east over the Mysore Plateau and Tamil Nadu plain before it joins the Bay of Bengal, irrigating a vast stretch of fields in its delta region in the Thanjavur district.

The Cauvery flows through areas that are geologically stable and the course of the river is predictable. Its birthplace in the Western Ghats is characterised by dense tropical evergreen forests. This area is marked by lofty trees, multi-storeyed vegetation and trees that do not shed their leaves in any season. The river also flows along tropical moist deciduous forests (trees that shed leaves during spring and summer) that yield commercial timber and other valuable forest produce such as rosewood, teak, ebony, sandalwood and fruits like ber, amla, jamun, etc.

Leaving the hilly terrain, the river enters the fertile fields of Mysore which are predominated by clayey red soil. The soil is rich and contains oxides of iron and manganese compounds.

The Cauvery is fed by the monsoons, which means that during the monsoon it carries a very heavy flow of water. Although the river has a past record of serious floods, in recent times the efficient irrigation system has prevented flooding to a large extent.

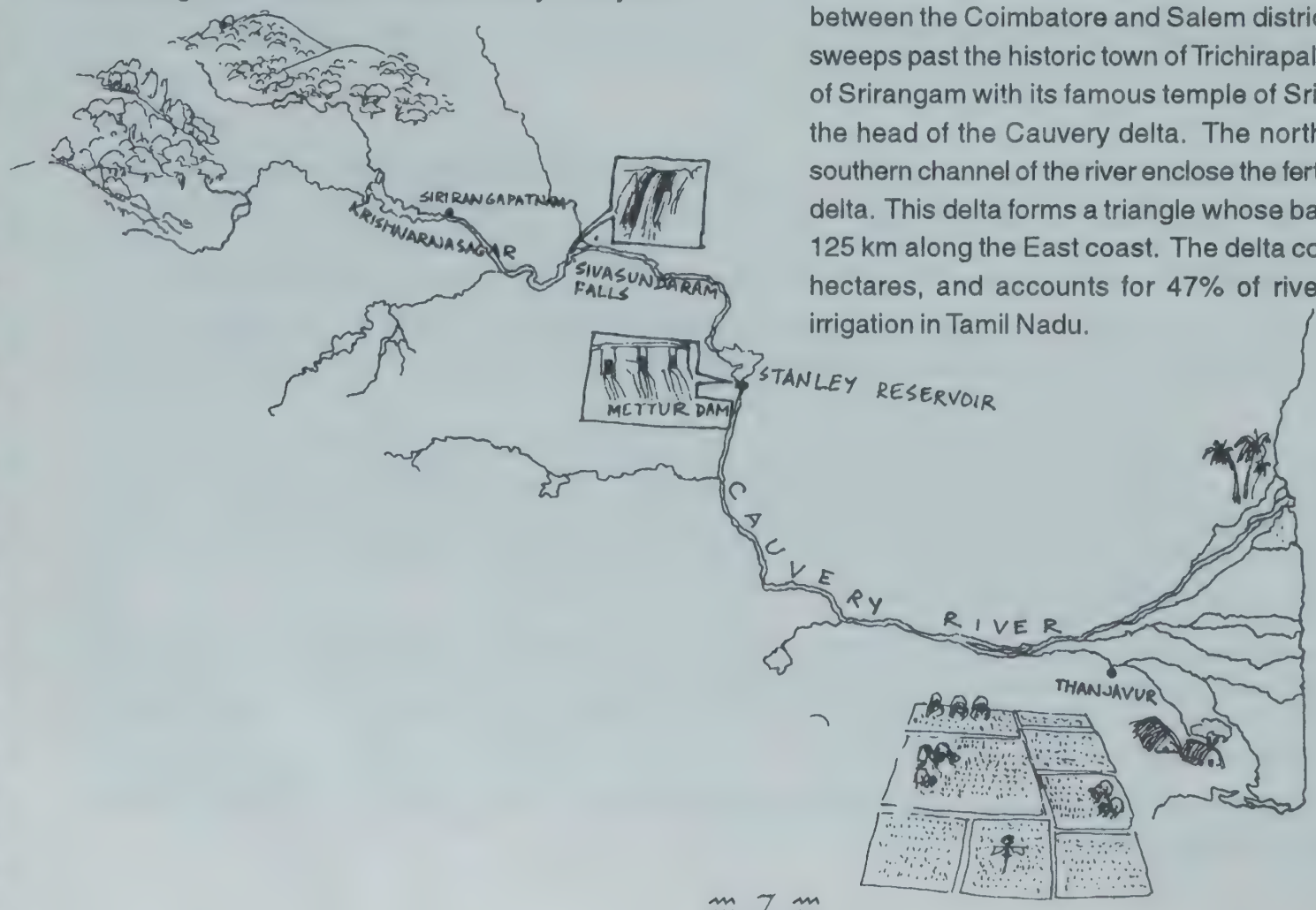
The Grand Anicut which dates back to the second century AD is the earliest attempt to control flooding. This masonry structure, over 300 m. long, 18 m thick and over 5 m. high constructed by Karikala Cholan with subsequent improvements made over the years is still functional today. It irrigates four lakh hectares in Thanjavur and Trichirapalli districts through 6400 km long channels.

There are four major dams across the river and in many places a number of smaller dams and anicuts have been built for irrigation, some nearly 2000 years old.

The crops grown in the Upper Cauvery region in Karnataka are rice, sugarcane and irrigated dry crops.

There are rice farming lands in Tamil Nadu in the 140 km that parallels an extremely straight coastline. Today some of these paddy fields are being converted into more paying prawn farms. As a result saline (salty water) needed for prawn cultivation is entering the soil, and adversely affecting the surrounding rice fields (see the piece on pg 62). Over 95% of the Cauvery water is utilized regularly. Unfortunately today 5082 lakh million gallons per day of effluents (industrial wastes) pollute the river, and 80 lakh million gallons per day of untreated sewage is discharged into it.

On entering Tamil Nadu, the Cauvery forms a border between the Coimbatore and Salem districts. Further it sweeps past the historic town of Trichirapally. The island of Srirangam with its famous temple of Srirangam is at the head of the Cauvery delta. The northern and the southern channel of the river enclose the fertile Thanjavur delta. This delta forms a triangle whose base stretches 125 km along the East coast. The delta covers 14 lakh hectares, and accounts for 47% of river and canal irrigation in Tamil Nadu.



"Slashing the banks, twisting and turning,
The bright blue water flows in the Cauvery,
In swirls and whirls
The pure water glitters like silver
Water to drink, and water to bathe.
In pots and pans they take it away
This water has no pollution
It is cold water to the Brahmin
It is cold water to the untouchable
What they all worship is the same cold water
What they fight about is also this same cold water"

Folksong from Tamil Nadu

The legend of the Cauvery

According to legend Cauvery is the daughter of Brahma, the foster daughter of Sage Kavera, and the wife of Sage Agasthya. One of her preconditions for marriage to Agasthya was that he should never leave her alone for a length of time or else she would transform herself into a river and go to the sea.

It so happened that one day Sage Agasthya spent a long time bathing in a river. Thinking that he had broken his promise, Cauvery who was in the Sage's 'kamandala', flowed out of it in the form of a river.

On his return Sage Agasthya pleaded with her to come back. Cauvery complied, but assumed two forms: one as the river, and the other as his mortal wife. Sage Agasthya was very happy and chalked out the course of the river Cauvery, and blessed her that she would bring prosperity wherever she flowed.

Ikkedaya Aa Mannu Neladalli
Hunu Beleyannu Bithutha
Aalekki Belluki Harive Haarure
Kaveriya Bala Beerutu

Kochu Kulu Kanu Paavaripagalali
Puthu Ni Hariyuve
Poonye Thirthav Kallu Bhoomige
Bhoomiki Sut Ni Salahuve

Translation from Kannada

Wherever the Cauvery flows on the land, it makes the soil rich, and the fields are filled with green. The Cauvery washes away our dirt and our sins. The purifier flows in our land.

From the Pattinappalai

Where the red waters of Cauvery meet the clear waters of the sea, live the Paradavars, the deep sea fishermen of Puhar. The 'Pattinappalai', written centuries ago gives a vivid description of their lives, in particular their holiday activities.

"On the wide dune of black sand, the large clan of rough working `Paradavar' were seen eating the cooked flesh of the sea-fish and the boiled field-turtle. Wearing flowers of the `adambu' and the water-lily, they gathered in the spacious `manram' like the stars and planets revolving in the blue sky. The stronger ones among them entered the wide arena and, without turning back, they fought fierce duels hurting one another with their fists and their weapons. Birds flew from the mottled palms, frightened by stones shot from slings. In the outer streets, pigs were wallowing in puddles with their young ones, together with many kinds of fowl, and rams and quails were seen fighting.

Their huts with low thatched roofs in which were stuck the long handles of fishing rods resembled the little enclosures round hero stones made of rows of shields and spears. In the midst of these huts, fishing nets were drying on sandy thresholds, like patches of darkness in bright moonlight.

Wearing garlands of the cool white convolvulus growing at the foot of the screw pine (with aerial roots), they planted a branching jaw-bone of the sword fish and invoked a mighty god to dwell in it. Decked in the long-petalled 'talai' (pandanus) flowers, the big red-haired fishermen drank the toddy of the rustling palm in the company of their dark women clad in garments of green leaves. Refraining from going fishing on the wide blue water, they ate and sported on the sandy beach reeking of the smell of fish."

ecology of a river

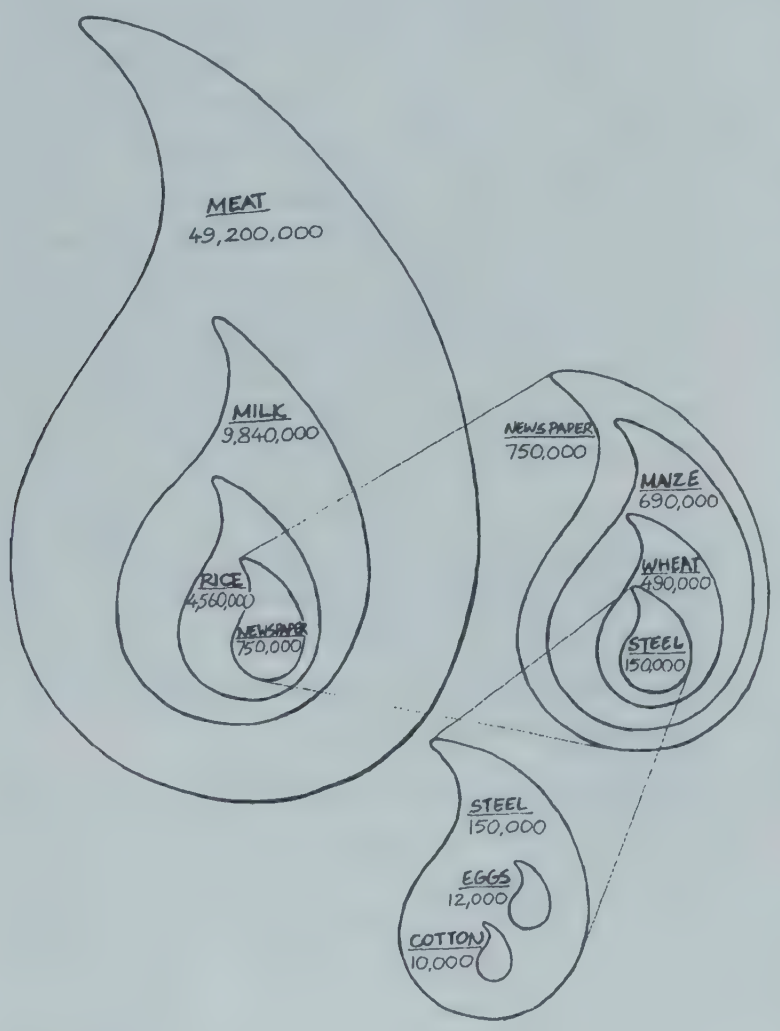
"Till taught by pain
Men really know not
what good waters' worth"

Byron, Don Juan

WATER: CRUCIAL TO OUR LIVES

Did you know that people can stay alive for weeks without food, but they live for only six days without water?

This is because approximately 65% of the weight of an average human being is made up of water. When the amount of water goes down by even 1%, we feel thirsty, a 5% drop can cause the skin to shrink, the mouth and tongue to go dry, and can even result in a person 'seeing' hallucinations. A drop of 15% can cause death by dehydration.



These drops indicate the number of litres of water needed to produce just one ton of the products shown. Note that it takes 5,000 times more water to produce meat than to produce cotton.

The water that flows in a river is known as 'fresh water' to distinguish it from the 'saline'(or salty) water we find in the sea. Even though as much as 75% of the world's surface is covered by water, we cannot use it either as drinking water or for irrigation. In fact only 3% of the world's water is freshwater, and most of this comes from the rivers of the world.

Even though water is odourless, colourless and tasteless, it is a chemical that is completely unique. It is a compound of great stability, a remarkable solvent and a powerful source of chemical energy. When frozen into a solid it expands, instead of contracting as nearly all other substances do, and the lighter solid floats on the heavier liquid - with astonishing results. In many physical properties - such as freezing and boiling temperatures - water is an exception to the rule.

Over hundreds and millions of years water has been one of the most powerful agents in shaping and reshaping the earth. Scientists believe that life began in the earth's primeval oceans, and till today water continues to support all life. Some very simple organisms can exist without air, but none can grow without water.

Water is the only common material that exists naturally in all three states - liquid, solid and as a vapour - on earth. Till very recently scientists believed that the earth was apparently the only planet in the solar system that sustains water in this way. This has not only determined the course of life on earth, but may have limited life, within the solar system, to earth alone.

Water is restless in nature, it is never still. Look at a glass of water with ice cubes in it. Simultaneously the ice cubes get converted into liquid, releasing a tiny amount of vapour into the air above the glass, and this vapour condenses into droplets on its smooth glass sides.

But in one important respect, the behaviour of water is steady - its total supply on earth neither grows nor diminishes. Till today the amount of water on planet earth has remained more or less the same as it was three billion years ago.

Develop A Food Chain

These cartoons are an amusing version of a food chain. Can you develop a food chain for your own river?

All the plants and animals that live together in a certain place make up a community. They are dependant on one another, and a change in any one part will upset the delicate ecological balance of the entire community. For example, the green plants in a water body produce oxygen, which is essential for the animals and plants to be able to breathe in the river.

A totally different plant and animal life exists where the river meets the sea. These 'wetlands' as they are known are estuarine habitats. Mangrove trees such as we have in India are ideal inhabitants of these areas. Their roots are adapted to the stagnant, airless mud they grow in and 'prop' roots exist to provide stability. Some mangrove seeds germinate before they fall to ensure quick propagation. Fish, fish eating birds, crocodiles and crabs thrive in a mangrove swamp. These swamps with a history of 60 million years, are threatened today by shipping, industry and paddy cultivation.

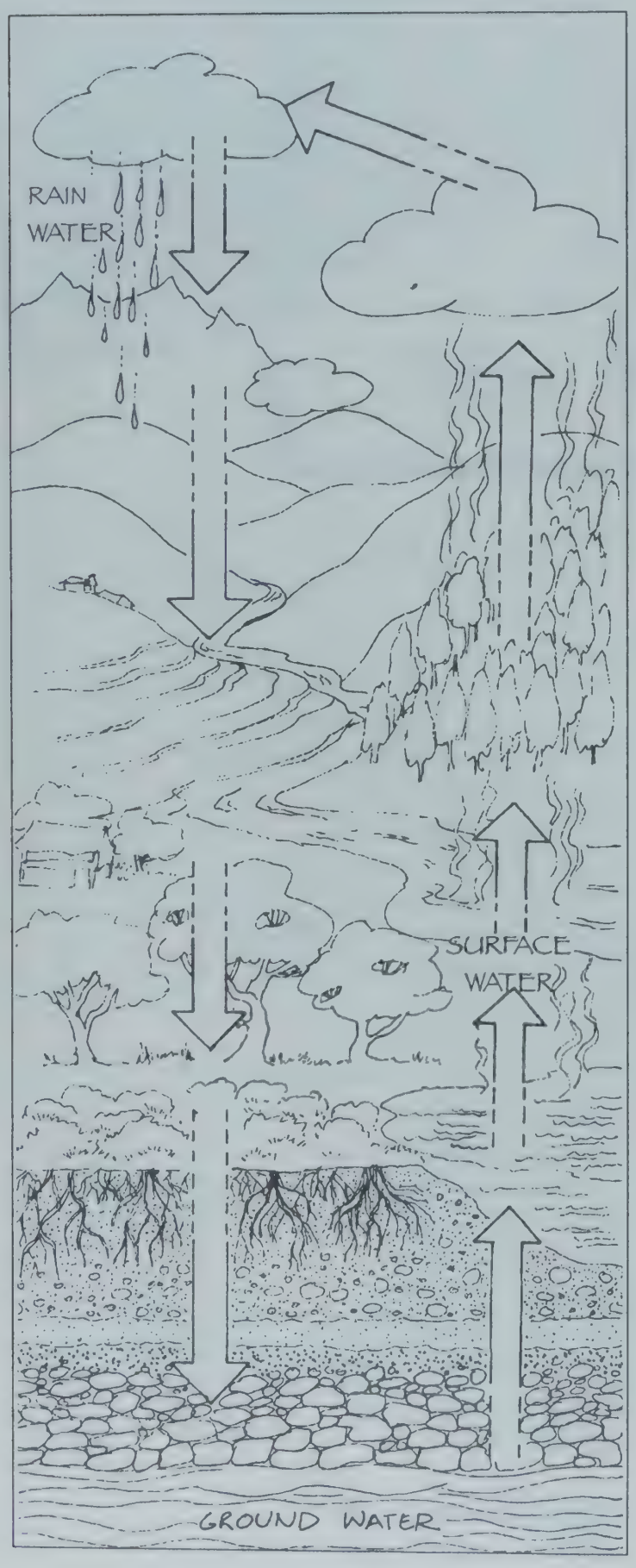
For more information, read the double-spread on Mangroves that follows this chapter.

• My dear, dear girl,
Now the rains are here.
Their trampling feet
Echo in the death-like dark,
And lightning - streaks join the hill-top
To the singing deep stream below.
Streams come cascading down the hill.
The refrain of thunder
Echoes in the forest.
In the dark cold
The moon is wiped out,
Stars are no more,
Sky and earth encased
In primeval dark;
Shivering cold, the rains,
Rains sing down from the rooftops,
And then flow away,
In nameless water torrents.
In ecstasy the flowering kadamba tree listens
To the splashing streams and the frogs' music,
Your coming, the rains.
The new bride washes
The feet of elders,
You are the rain, the new bride,
The rain drops are you,
They fill me up.

Song of the Paraja Tribe
who live in Korapat and Kalahandi

THE WATER CYCLE

We all have studied about the water cycle in detail, but are we familiar with the various facts and figures connected to it in our own country? Read the adjoining column to get a clearer idea of the freshwater problem.



The sub-continent of India receives more rainfall/snowfall than any other continent in the world except for South America. Every year, during the monsoons, 320 million hectare metres of water descend on the Indian subcontinent. If all of this rainfall were collected, it would form a sheet of water over our landmass, one metre thick.We use only 1/10th of this every year, and even in 2025 A.D. we will only be using 1/4th .

CAN WE HARNESS THE REST OF THIS RAINFALL/ SNOWFALL TO MEET OUR EVER INCREASING NEED FOR FRESHWATER?

Only 1/5th of all rainfall in India enters the rivers, and most of this percolates the soil and becomes ground water. We still need to investigate what happens to the other 4/5th.

THREATS TO THIS CYCLE COME FROM:

Dams that block the flow of a river and therefore have a negative impact on the area downstream the dam, which no longer receives a flow of water.

Excessive and indiscriminate use of the ground water by the sinking of too many **tube-wells and bore wells.**

Industries that use water to generate electricity and to cool or clean equipment. Although 80% of this water is returned to its source - it is often polluted and at a much warmer temperature than it was, when taken out. This can severely affect the ecological balance of the river and plant and aquatic life.

Deforestation affects the amount of water percolation into the soil and the moisture that can be retained in an area. Vegetation assists water percolation. Rain filters through the leaves of a tree and helps it to transpire. Reduction in this moisture level leads to low levels of condensation and ultimately less rainfall in the area.

Landslides occur when the rain batters the soil, resulting in erosion. Often the silt piles up in the rivers, blocking their flow.

Construction and habitation right upto the water's edge, results in erosion and pollution.

Acid rain caused by emissions of sulphur dioxide and nitrogen oxides from industries and motor car exhausts affect the entire water cycle by making rain water acidic.

DID YOU KNOW ?

- Of the soil that is carried by the flow of water in a river, 61% settles in river beds, 10% in dams and 29% goes into the ocean.
- As much as 1/4th of the 8000 million tonnes of sediment deposited in the Bay of Bengal regularly comes from the Ganga and the Brahmaputra.
- Every year 40,000 cubic metres of water evaporates from the oceans into the atmosphere.

FRESH WATER AND RIVERS

Fresh water can be found either flowing in a river or stream, or as the still waters of a pond or lake, which are often fed by rivers.

Over time rivers tend to become full of silt and are invaded by aquatic plants. The growth of these plants encourages the silting up process further, because they slow the flow of water. As a result this body of fresh water first turns into a swamp. Swamps support an even wider range of animal and plant life than a rain forest and are therefore known as the most productive habitats on earth. Later the swamp becomes the same as any other patch of land. In this way over time rivers become land. Such a process takes several thousand years.

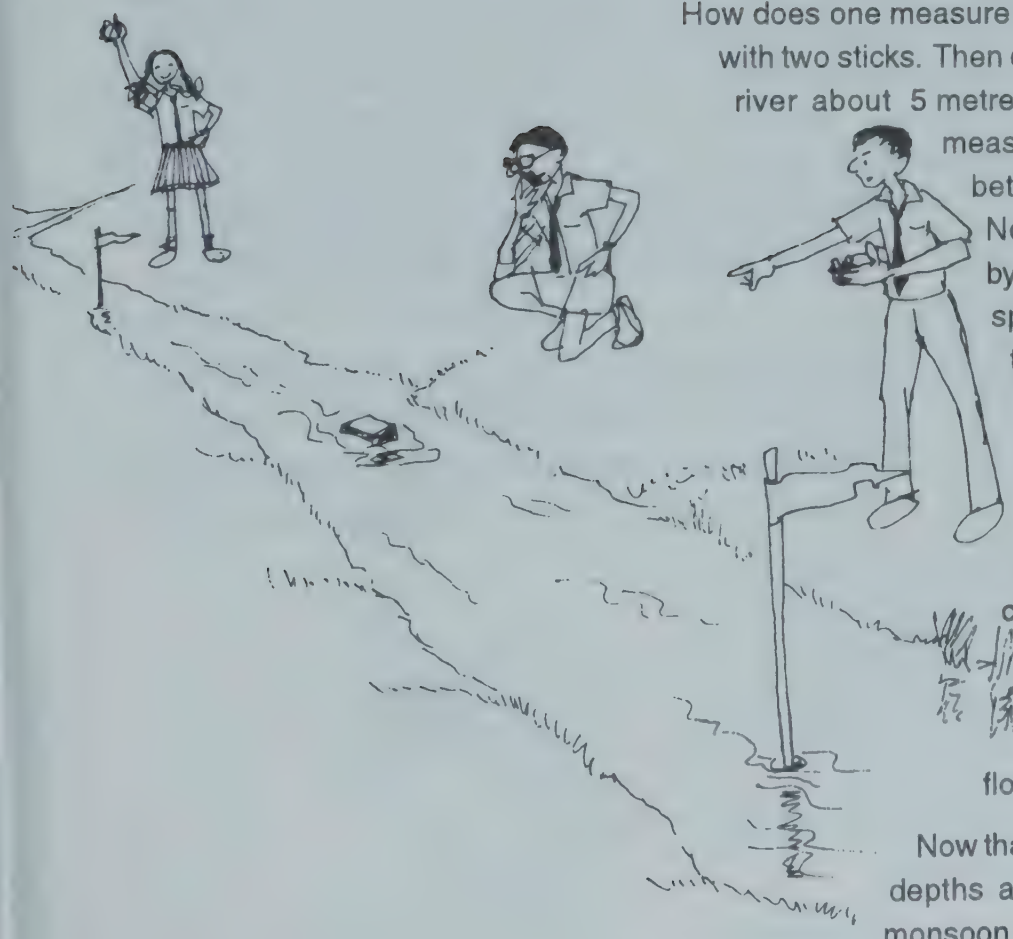
What is important to understand is that each freshwater habitat creates it own complex and unique ecosystem. Rivers such as the Amazon or lakes such as Lake Victoria in Africa have developed their own unique fauna or species that exist nowhere else in the world. (See pg 30 for examples of flora and fauna in the Amazon).

However the following factors determine the kind of flora and fauna a river can support. Read the text and carry out the experiments yourself to understand these factors.

A. The speed at which the river flows makes a critical difference to the wildlife that is found there. For example, the same river flows at a fast pace in the mountains and as a result the sediment at the bottom is not stable. It can therefore sustain very few species of animal and plant life. The only possibility here is for plants to attach themselves to sheltered spots in rocks. The slower movement of this same river when it reaches the plains, allows the development of a totally different plant and animal life.

Activity

MEASURE THE SPEED OF A RIVER



How does one measure the speed of a river ? Mark a 20 metre stretch of a river with two sticks. Then drop a small piece of wood or a cork into the middle of the river about 5 metres upstream of the upstream marker. Using a stopwatch measure the time taken by the piece of wood/cork to travel between the upstream marker and the downstream marker. Now you can calculate the speed of the flow by dividing 20 by the number of seconds. Your answer will give you the speed of water in metres per second. Repeat this several times to calculate the average speed.

Think of how you can find out the following:-

a) Does the amount of water flowing in the river affect its speed ?

b) How fast does the river flow around a curve/bend ?

c) Does water flow at the same speed at different depths ?

d) Can you notice a difference in vegetation within the water/on the banks/on islands? Can you correlate any of these with the different speeds at which the water is flowing at various places?

Now that you understand that a river has varied speeds at different depths and in different seasons, think of the consequence of monsoon flooding or how building a dam on a river affects its speed and therefore its entire ecosystem.

B. **The transparency of the water i.e the amount of sunlight that percolates the water directly affects the photosynthesis that all plants must carry out to be able to live. The more turbid the water, or the deeper the water, the less light you get.**

Activity

HOW LIGHT AFFECTS THE GROWTH OF PLANTS

To understand how **light** affects the growth of plants, carry out the following experiment at school or at home.

Prepare three pots of seedlings of those plants that grow best in sunlight. Place one in a place that will receive sunlight for most of the day, one in a semi-lit area and the third in the dark. Observe the height of the three plants over several weeks and keep a graph to indicate their growth.

A similar situation occurs underwater, where the amount of light that percolates affects the growth of the plants. Garbage on the surface or water hyacinths block the passage of light, oxygen and minerals and therefore slowly suffocate the river.

C. **For aquatic animals a regular supply of oxygen becomes essential. Icy water contains one twentieth the oxygen that air has and warmer water contains even less. What impact do you think this has on aquatic life?**

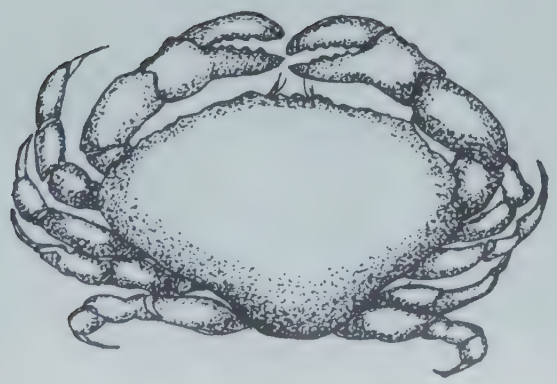
Activity

WATER CONTAINS OXYGEN

To understand how water contains oxygen try the following. Fill a clean glass jar (like a jam bottle) with tap water and set it in front of a bright window. Watch the water at the top and very soon you will see air bubbles rising to the surface. After the bubbling has stopped and the water becomes clear, add a teaspoon of salt to the jar. Screw the lid on the jar and turn it over once. Then return the jar to an upright position. Study the water again. More bubbles will rise to the surface. Where did these come from ?

As you added the salt to the water, more oxygen was driven from the water because the salt dissolves more easily in the water than the air, and it replaces the air. The air is then driven to the surface as bubbles.

It is this oxygen dissolved in water that fish draw on though their gills to be able to breathe.



The earth does not belong to man
Man belongs to the earth
All things are connected
Like the blood that unites us all
Man did not weave the web of life
He is merely a strand in it
Whatever he does to the web
He does to himself.

From a letter by Chief Seattle
to the President of USA in 1855

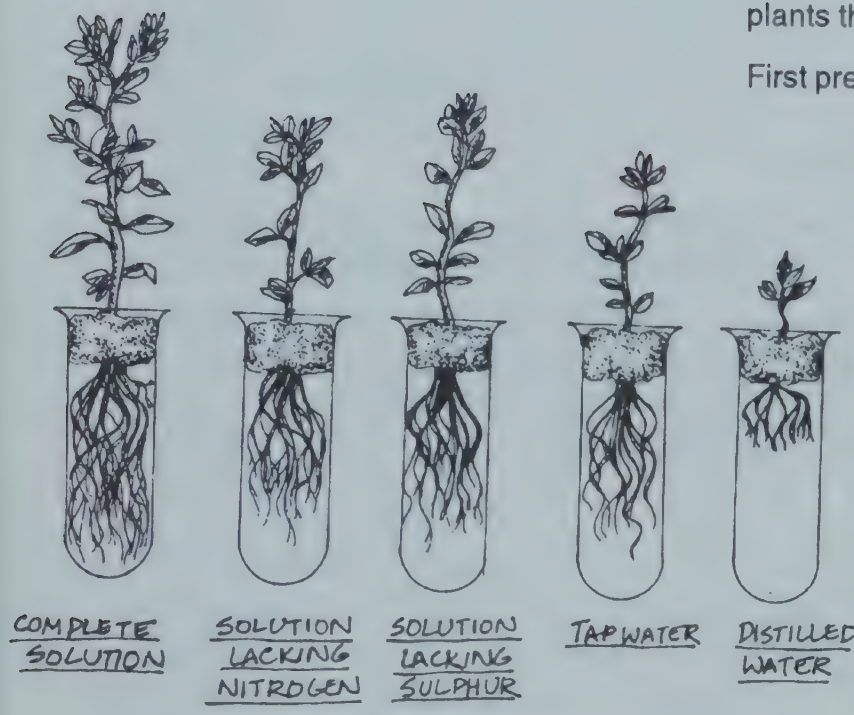
D. The chemical composition of water of a river i.e. the different levels of mineral salts it contains also largely influences its animal life.

Activity

CHEMICAL COMPOSITION

To understand how the chemical composition of water affects the life of plants that grow in it, carry out the following.

First prepare four variations on this basic nutrient solution



Nutrient Solution Recipe
10 g. calcium nitrate
2.5 g. potassium phosphate
2.5 g. magnesium sulphate
2.5 g. potassium nitrate
Pinch of ferric chloride
1 litre distilled water

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Grow one plant in the complete solution, one in tap water and one in distilled water alone. For the others use the nutrient solution lacking nitrogen (replace calcium nitrate with calcium chloride), and the solution lacking sulphur (replace magnesium sulphate with magnesium chloride). Germinate the seeds in a blotting paper, before transferring them to the test tubes. Record variations in growth.

This experiment clearly indicates the effect of certain essential minerals without which plants cannot grow.

All the four activities indicated above bring into sharp focus important natural factors that keep an ecosystem alive. But any interference in any one of these can adversely affect the entire ecological balance, and the life of a river.

Keeping our rivers not only free from pollution, but also maintaining their state of dynamic balance - in other words 'conserving' their ecosystem is crucial for our lives.

The ecosystem is a complex web linking animals, plants, air, water and every other life form in the biosphere. It can range in scale from a fish-tank to an ocean, a lawn to a rainforest. Every ecosystem hangs together in a state of dynamic balance. Human survival depends upon preserving the ecosystem. It's the boundary of our existence, the framework of all human activity. We can't do without the ecosystem, as long as we live on earth.

The ecosystem of a river, like any other ecosystem is based on the three very simple principles that underlie ecology.

Firstly, everything in Nature is connected with everything else. Second, everything goes through a natural cycle and third, Nature maintains the ecological balance!

THE FOOD CHAIN

Have you ever looked at the state of water in a vase of cut flowers?

Over the last few days since you filled the vase, the water has turned green in colour. This 'green' indicates the growth of simple plant life called **algae**.

This plant, with its weird slippery touch can be found clinging to rocks on the banks of a river, or even on rocks that lie in the river bed - especially at the area that is the river's source. The tremendous speed of the water here does not allow any other mature plant to grow, so the algae survives and thrives.

Algae forms the food for several river insects and animals. They are eaten by large numbers of water fleas and gnat larvae, and form the beginning of an entire **food chain**. Algae or even fallen leaves in river, known as plant litter, provide rivers with an important input of nutrients.

This food chain will include herbivores, carnivores and omnivores. **Herbivores** are animals that feed on plant material, while **carnivores** are those that feed on herbivores. You will be surprised to know that carnivores include water beetles and water spiders, and even dragonflies!

Omnivores are animals that eat both plants and animals. For example both you and me are omnivores, as we eat both plants and animals. A fourth group are **scavengers** - who eat dead leaves, dead animals and the droppings of animals. Freshwater shrimps are a good example of scavengers.

"To rid the Ganga of the ghastly human carcasses between Varanasi and Calcutta, the Ganga Protection Directorate released flesh eating turtles into the river so that they would feed on the carcasses. Before releasing them, the Ganga Protection Directorate experimented and found that six captive turtles ate a roasted pig of 35 kg.in less than 6 hours. But unfortunately most turtles released in the Ganga, landed in the fishermen's nets - 61 live turtles were found in a Calcutta Market on December 21. There is a high demand for turtles due to their delicious meat. As a result the scheme has been abandoned." The Statesman, January '95.

Look at the two news items given here - and you will begin to comprehend how the ecology of a river is threatened from all sides.

'The golden mahaseer - one of the most valuable gamefish in the world used to thrive in the Himalayan foothills till a few decades ago. Dams have halted its migration upstream for spawning, and it also faces a threat from fishermen using dynamite to kill and catch it.

The dynamite or a specialgelatine stick of highly explosive chemicals like nitroglycerine or nitrocellulose, is moulded into the size of a tennis ball, packed into an empty vegetable oil container along with nails, metal and glass pieces which act as missiles. This bomb is provided with a waterproof fuse, normally a candle wick. The detonation of the dynamite acts on the nervous system of the fish, stupefying it - so it floats stunned on the surface of the water, or is instantly killed by the nails and metal pieces that act as bullets.

The gelatin stick affects the flora and fauna over an area of 30 feet and has a devastating impact. It reduces the oxygen content of the water, destroys the natural arrangement of rocks inside the river and the shelter of aquatic animals, and destroys the micro organisms on which the fish feed. The fish either die of starvation, or have a damaged brain and stunted growth."

Activity

WATER CONSERVATION AT HOME

Did you know that on an average your family pulls the flush 16-20 times a day? Each time about two buckets of water are flushed out. So about 32-40 buckets are used daily! Multiply this by 365 and you will have the average amount used annually !

Activity

HOW CLEAN IS RAINWATER?

Many of us believe that rain water is the cleanest of all water, but we do not know that as rainwater falls, it absorbs carbon dioxide from the air. The rain water therefore becomes a very weak acid which will dissolve limestone or chalk.

Vinegar is also a weak acid. So you can experiment by using vinegar in place of rainwater. Put small pieces of chalk (not black board chalk) and limestone in a saucer. Pour a little vinegar over it. Watch what happens. What do you see? What do you hear?

This experiment indicates what happens when only CO_2 dissolves in rainwater. But in actuality the air, in particular the air over our cities, contains several other chemicals as well. Chemicals that come from automobile exhausts, factory chimneys etc. What effect will these chemicals have, when they dissolve in rainwater? Do you think this is linked in any way to the concept of 'acid rain'?

Here are just some of them

As (arsenic) : from coal and oil furnaces, glass manufacturing; long-term exposure may cause lung and skin cancer.

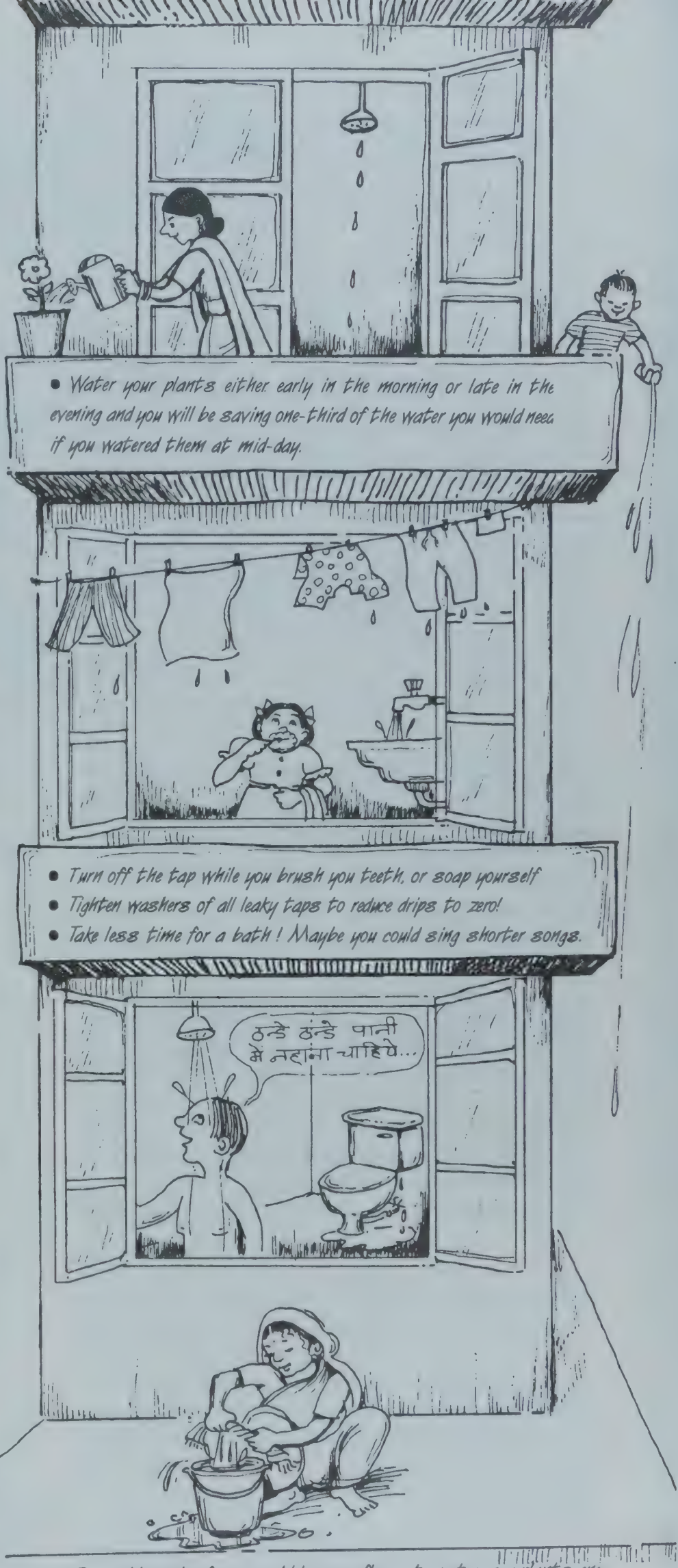
C_6H_6 (benzene) : from refineries, motor vehicles; long-term exposure may cause leukemia.

Cl_2 (Chlorine) : from chemical industries, forms HCl; irritates mucuos membranes.

CO (carbon monoxide) : from motor vehicles, coal and oil furnaces, smelters, steel plants, starves body of oxygen, damages heart and the brain.

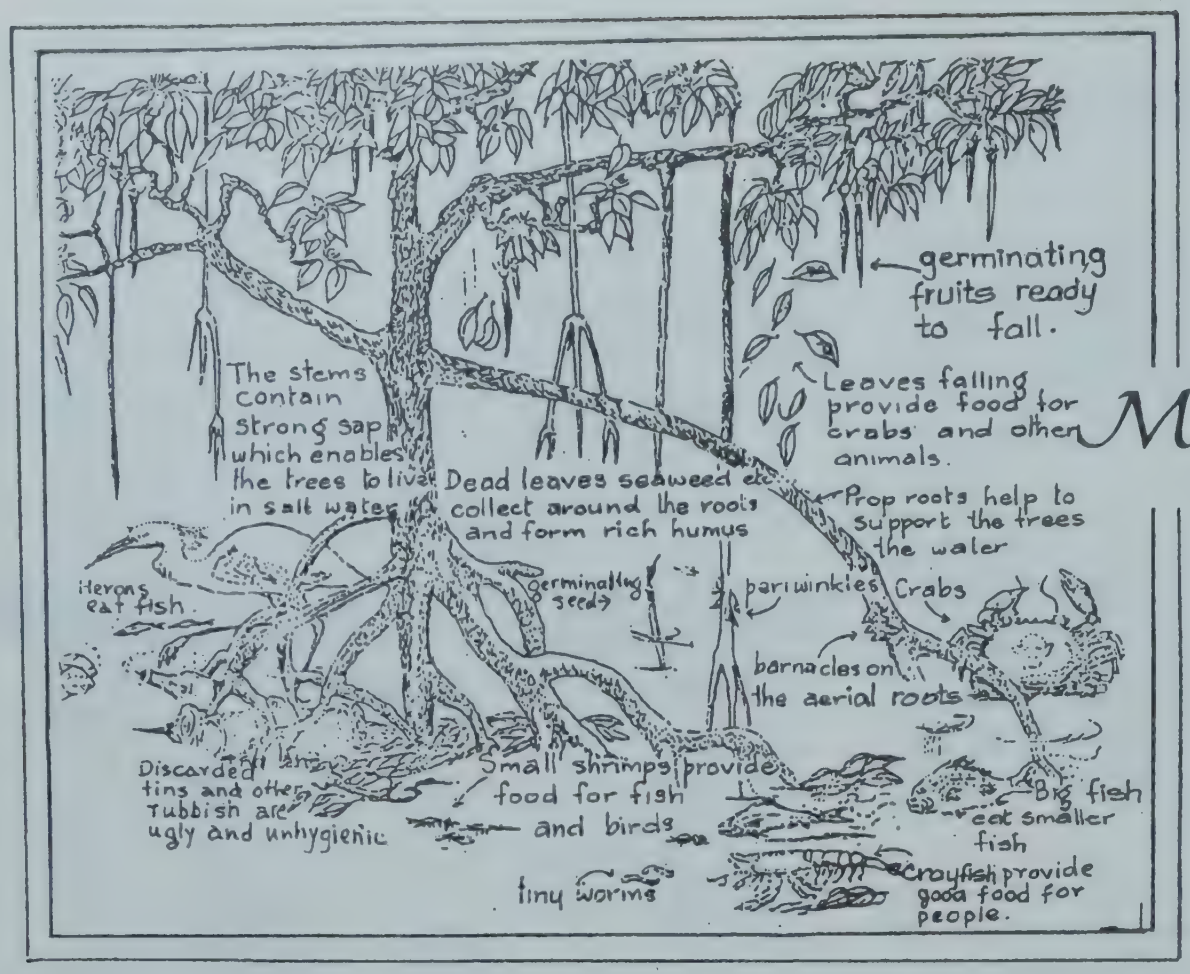
HCl (hydrogen chloride) : from incinerators; irritates eyes, lungs.

H_2SO_4 (sulphuric acid) : formed in sunlight from sulphur dioxide and hydroxyl ions; causes respiratory ailments.



- *Water your plants either early in the morning or late in the evening and you will be saving one-third of the water you would need if you watered them at mid-day.*
- *Turn off the tap while you brush you teeth, or soap yourself*
- *Tighten washers of all leaky taps to reduce drips to zero!*
- *Take less time for a bath ! Maybe you could sing shorter songs.*
- *Reuse the water from swabbing your floors to water your plants and think how much water you will be saving (But remember, there must be no phenyl or detergent in the water).*

Mangroves


germinating fruits ready to fall.
The stems contain strong sap which enables the trees to live in salt water
Leaves falling provide food for crabs and other animals.
Dead leaves seaweed etc collect around the roots and form rich humus
Prop roots help to support the trees the water
Herons eat fish.
germinating seed
periwinkles
Crabs
barnacles on the aerial roots
Discarded tins and other rubbish are ugly and unhygienic
Small shrimps provide food for fish and birds
Big fish eat smaller fish
tiny worms
Crayfish provide good food for people.

Our country has a total mangrove forest area of 6,740 sq km., 70% of which is on the east coast of India. Mangroves form an essential part of the 'wetlands' in our country, and as an ecological system, wetlands are extremely important. Let's understand how.

Most people look upon wetlands as waste lands, inconvenient and unusable spaces which would be better off drained, filled, plugged, dammed or flooded. All over the world, particularly in industrialised countries, millions of hectares of wetland have been lost as they are changed into dry land for roads, markets, hotels, airports... Commercial interest groups and their allies in the government would rather ignore the need for biological productivity, clean air, fresh and shell fish populations, wild life retreats, water enrichment and flood control that are all a part of wetland functions. Thus wetlands are among the most endangered areas of the earth.

As an ecological system, wetlands are a very valuable natural resource. They serve as buffers against damage by floods as they absorb large volumes of the monsoon run-off, protecting the land beyond. Where this normal flow is blocked by new developments, road embankments and land fill, low lying areas get flooded, and there is a consequent increase in mosquito breeding pools. In the city of Bombay flood damage adding upto lakhs of rupees, occurs every monsoon on property that was at one time wetlands.

Mangroves are salt tolerant trees that are found in tropical estuarine regions. In India the best known mangrove forests are situated in the Sunderbans of Bengal (Look at the box item on pg.55 too).

A mangrove tree or plant has adapted itself completely to living in saline water. For example:-

- The tap root found in most mangrove plants is shallow and therefore is unable to support the tree. As a result special root systems called prop roots are developed. In addition there are other roots which grow upwards, and allow the plant to breathe.
- Mangrove plants are able to survive high salinity because their leaves are highly succulent and thick so that they retain water. Consequently, in spite of being in a highly saline environment they do not get dehydrated.
- Some mangrove plants show vivipary i.e. germination of seeds inside the fruits before they are shed from the parent plant.This is an adaptation made by the plant to survive in a hostile environment.
- Did you know that a mangrove community has twice the rich variety of living species of other wetlands? This is because of the nutrient rich sediment in the waters surrounding the mesh of mangrove roots. Many species find a hospitable environment here, which provides shelter, space and abundant food to them.

Today mangroves across our country are threatened because they are being cut for timber and firewood. Wetlands are being used for agriculture and aquaculture (particularly prawn farming) and building. Only 1% of mangroves, internationally, are protected.

Land which is temporarily or permanently under shallow water, and has a rich and specific vegetation that is tolerant to water logged soil conditions, is known as a 'wetland'. Mangrove habitats are an important part of coastal wetlands. Mangroves are those plants which can grow in a mixture of saline (salty) and fresh water, like an estuary, backwaters, a lagoon, etc.

Mangroves are not the name of a particular tree, but rather a generic name.

Activity

WETLAND TREASURE TROVE

1. With your group, discuss the wetlands that you are most familiar with and try to identify plants, birds, animals that would be found in each. The wetlands may be salt pans, mangroves, marshes or khazan (areas of wetland used for cultivating paddy) lands. Think of how these wetlands are used by man, by animals and by nature. What happens to water, tides and soil in wetlands?

2. Now introduce the objects you have brought to the entire group. A sponge, a sieve, an egg beater, digene tablets, a fruit bowl, a watering can, a pillow and some rice grains.

Pick up the sponge and let others tell you how a sponge is used. Do the same with a sieve, the egg beater and the rice grain. Ask how these objects might represent functions in a wetland.

List these on the board in this way :-

FUNCTIONS OF WETLANDS

Sponge - absorbs excess water and runoff
Sieve - strains out silt and debris
Rice - provides nutrient rich food for plants and animals.

Can the others think of some more activities that go on in wetlands and link it to an item/object?

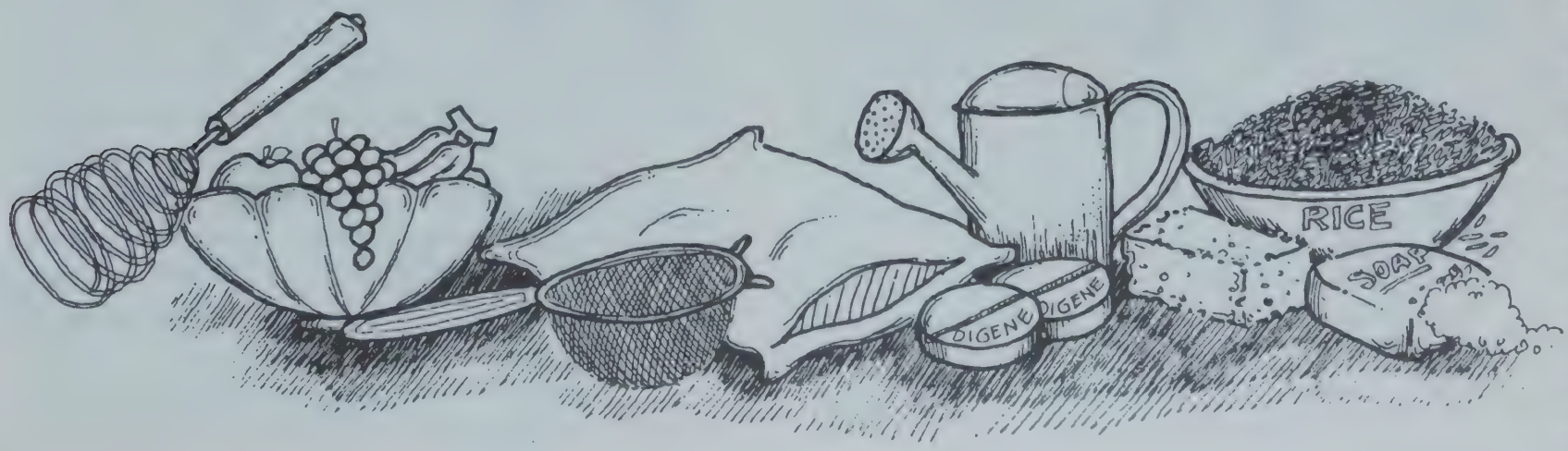
3. Now form groups of four to six and give each group a copy of the list you have prepared. Tell the students that each of the items listed has a use, or is related to a function that is to be found in any of the wetlands of India. Each group must examine the functions of the item and link it to a related function in the wetlands. Set a time limit of 15 minutes.

Once the time limit is up, let each group report their ideas to the class. Allow time for questions and suggestions. Do not ridicule any idea!

Review the list of items and link these to appropriate functions. Ask students to select those items that represent the three most important activities of a wetland zone. Discuss how our wetlands are economically, ecologically and aesthetically important to us.

• • •

To study bird life in mangroves, students of Vidya Mandir in Chennai visited the banks of the Adyar estuary. There are about 200 species of birds found here. We can hear the cries of many birds in summer such as yellow wattled lapwing, bush lark, finch lark, pipit and bee eater. Spotted doves, bulbuls, drongos, kites, mynahs, parakeets, golden orioles, tailor birds and several others can be seen nesting here. In winter, the estuary is the haunt of migrant birds from the North. Thus if one visits the mangrove forests on the banks of the estuary, one can observe Nature at very close quarters.



Flora and Fauna

"We entered an enchanted garden, where the produce of Europe and Asia - indeed every quarter of the world - was blended together. Apples, pears and pomegranates, plantains, figs and mulberry trees, grew in the greatest quantity, and with the most luxuriant hue. Blackberries and raspberries, hung temptingly from the brows of the broken crags, while our path was strewed with strawberries. In every direction, were blooming heather, violets and jasmine, with innumerable `rose trees in full bearing'....I have beheld almost all the celebrated scenery of Europe, which poets and painters have immortalized, and of which all the tourists in the world are enamoured; but I have seen it surpassed in these .... unknown regions of the Himalaya."

This was the impression of Thomas Skinner, in his book '*A Walk over the Himalayas to the Source of the Jumna and the Ganges*', published in 1832. Today, 167 years later, much of the flora and fauna of the Himalayas has been devastated by man. This destruction is now threatening India's perennial rivers.

From many media news and articles you will understand how much of the worlds' flora and fauna is on the verge of extinction.

Threatened World

NEARLY a quarter of all known mammal species around the world, over ten per cent of all bird species, a fifth of all reptiles, a quarter of all amphibians, and over a third of all fish --- mostly freshwater species — are at risk of becoming extinct. In fact, according to the 1996 Red List, a compilation of the world's threatened species by the World Conservation Union, about 5,200 species currently face the threat of extinction.

Of the 26 orders of mammals, 24 include threatened species, including nearly half the world's monkeys and apes; more than half of 18 species of hoofed mammals — among them rhinoceroses, zebras, and wild horses; a third of pigs, antelope and cattle species; and one quarter of all bats, bears and cats. The little-known California harbour porpoise has been reduced to just 100 individuals, while only 200 Tonkin snub-nosed monkeys survive in isolated forests of northern Vietnam. The pygmy hog --- the world's smallest pig species --- survives in only two wildlife sanctuaries in India. Worldwide, more than 1,000 bird species and 100 species of marine fish, including sharks, tuna, and seahorses, are also threatened with extinction.

The Red List, which was started in 1960 as a card file on 34 rare animals, blames increasing habitat loss, fed by human population growth and economic development, as well as pollution and climate change as causes for the declining numbers of animals worldwide. In fact, India along with Indonesia, China and Brazil, share the highest rates of both bird and mammal species at risk of going extinct.

Though disconcerting news for animal and nature lovers, the good news is that special conservation efforts can make all the difference. For example, though almost 44 per cent of the 23 species of 'crocodilians' --- crocodiles, alligators and caimans --- are threatened, conservation efforts have improved their situation. While in 1973, 100 per cent of the large reptiles were endangered, today seven species are abundant enough to allow sustainable use for skin trade, and five species have stable or increasing population numbers.

Every part of the earth is sacred to my people. Every shining pine needle, every sandy shore, every mist in the dark woods, every meadow, every humming insect. We are part of the earth and it is part of us. The perfumed flowers are our sisters. The bear, the deer, the great eagle, these are our brothers.

Chief Seattle

Flora : Generally the areas where rivers flow have abundant vegetation, since the soil is rich and fertile. However, in a country like India rivers can be found in varied terrain. In the north, they flow from high mountain glaciers to the plains and in the southern peninsula, they start in the hilly regions of the Western Ghats and meander through stretches of flat plateau land. While some are flanked by forests, others flow through miles of cultivated fields. The flora around Indian rivers, can therefore, vary from pine forests to rubber plantations to coconut groves.

The Yamuna for instance makes its appearance in the western Himalayas. At the river's source we find algae thriving, (see pg. 15) along with a variety of high altitude ferns and herb plants. The river then gushes through deep gorges in the higher altitudes (the alpine zone) where flowers of the rhododendron bush burst out in myriad colours when the snows melt. Many rare flowering plants cover the slopes and the banks of the river at this altitude. Sadly, these are disappearing rapidly.

From these heights, the Yamuna then flows through hilly gorges and valleys descending into the temperate altitude zones of the lower Himalayas and the Mussoorie hills.

Here, the change in the flora is remarkable: thick, dense forests of coniferous trees; the majestic deodars, the evergreen pines with their cones and needle like leaves cover the slopes of these hills. This area also has better known trees like oak, poplar and different varieties of rhododendron bushes.

"It was cool up in the hills and a crystal clear stream that crossed our path was icy to us plainsmen. It looked likely for our purpose: just 8 to 10 feet wide, sides overgrown with bamboo, hanging vines, ferns and rattan. The black rocks were slippery just on the stream edge; drier and covered in moss further away on the bank. The stream sounded beautiful to us with its open water singing and gurgling as it dove into dark crevices. Walking on the slippery stream side we had to be careful and this helped us slow down our pace, always extremely important and so difficult for outsiders. We usually tend to race and stumble through the jungle as if we were still part of the frantic traffic of our human world. Usually the jungle teaches you to slow down by catching you with incredible thorns and tripping you up on hidden roots or making you slip....

The first snake we found was a Vine Snake, I was looking down and spotted it just at my eye level. It made no effort to get away but puffed its throat and looked menacingly open-mouthed when I lifted it from the branch. It was a smooth deep green snake, when it puffed itself in defence the contrasting sky blue of the skin under the scales flashed. We bagged it carefully with a handful of green leaves. We would later photograph and release this harmless and beautiful but common and well known snake."

Romulus Whitaker The India Magazine, August '83.

HEALTHY DOLPHIN = A HEALTHY RIVER

Many rivers in the world have dolphins, and where they exist the dolphin is at the apex of the food chain. Just as the tiger in the forest is at the apex of the food chain. This means that as long as the dolphin is in good health and well, the eco-system of the river is also in good health.

Did you know that till ten years ago, hundreds of blind fresh water dolphins rolled and jumped in the depths around Varanasi's ghats? Blind, not due to pollution, but because as a rare species the Indian and the Pakistani species of dolphins have eyes, but eyes without lenses, which means they can only differentiate between darkness and light. As a result these blind dolphins use echo location to move around.

But recent surveys carried out in the Ganga indicate that only 3000 dolphins remain in this river and its tributaries, compared to the over 6000 that existed a decade ago. One of the major reasons is the increasing level of pesticides in the river, caused by run offs from agricultural fields. These pesticides get accumulated in the fat layers of these dolphins, and over a period of time they lead to the death of the dolphins.

Many of these dolphins migrated for breeding earlier, but construction of eight different barrages, such as the Farakka barrage, have put an end to this.

The introduction of nylon nets by fishermen results in many of these dolphins being caught and killed. Dolphins are much in demand by fishermen to extract their oil which is used as a bait to net catfish.

The habitat of the 'blind dolphin' stretched over 2800 km in the Indus river. Today, excessive hunting has forced this mammal into only a 170 km stretch of the same river between the Sukkur and Guddu dams.

But as those scientists who carried out this census survey of the dolphins said, " We must conserve the dolphin to conserve the whole eco-system of the river."

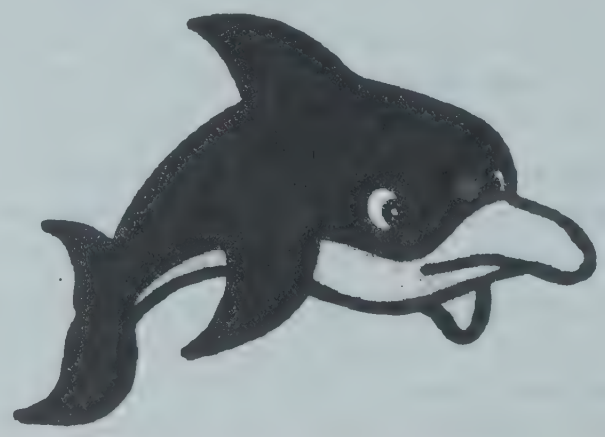
FAUNA

Just as there is an immense variety in flora, there are also innumerable species of fauna in the region through which the Yamuna flows. There is a close link between the flora and fauna and each area has its own particular variety of animals, birds and insects.

Animal life flourishes in areas where plants grow in abundance and are undisturbed. Forests and river banks are places where they both thrive. Today, this is all rapidly changing. Vast spaces are being 'used up' for many other purposes. Along with hunting and poaching, the very existence of faunal species are being threatened and depleted.

In the forests along the Yamuna, from its source down to the plains, there was once a great variety in the fauna. Tigers, leopards, elephants, bears, boars, hyenas, wolves, foxes and jackals were found. Some are still seen in select areas. Many types of monkey and deer abound in this area.

A great variety of birds are also found eg. flycatchers, jays and pheasants, orioles, wrens, warblers, tits, sunbirds etc. While talking of fauna, one normally thinks of animals in forests. Rarely do we link fauna with the many species that live in a river. Every river will also have its own particular population of such aquatic fauna. A number of amphibians, reptiles and fish are found in the Yamuna. Till a few decades ago several turtles and tortoise existed in these waters.



PAGES FROM A STUDENTS DIARY

27th October

Homeward bound! Our exciting trek to the Yamunotri area in the mountains with the Nature Club was over. We halted at Bharkot for a day to recover from our tiredness. An added bonus was the lovely hot meal at the Dak Bungalow. The cool pine forest and the Yamuna flowing at a sweeping curve 100 ft. below, over large boulders was a sight to remember. Many of us took snaps. Early next morning, at 6.00 a.m. we started our drive down the mountains. It was a wonderful experience. As we drove over the meandering roads skirting the mountains, we were surrounded by silent, delicate forests. The road wound around the high hills. Sometimes the river became a ribbon of water 500 to even maybe a 1000 ft. below our road flowing between gorges, and sometimes the road was at the base of the hills and we drove alongside the river. Here were small valleys and fields. Even though the fields were at the river's edge, the houses of the hill people who farmed here were higher up on the steep hill slopes. The mountain sides were covered with 'chir' pine with its needle-like leaves, quaint wooden cones dotting the branches and the pine trunks standing straight as sentinels..... At times we came across devastated hill sides, where trees had been callously cut and landslides had occurred. At other places we saw hillsides with newly planted young pine saplings. It was heartening to see that someone was trying to repair the damage. On leaving the hills behind and entering the plains we saw lush sal trees with bright green leaves. The forests were full of bird song. Later we reached Kalsi. There were many splendid mango orchards. We wished it had been summer-time - the mangoes would have been ripe.

We saw the river again. This time we were surprised. Innumerable logs were afloat on the water.... where did they come from? Where were they being taken? We thought of all the forests we had seen. Could these logs have come from them? Would the forests survive? Couldn't we do something about this? These were some of the questions we discussed amongst ourselves.

We drove on to the Tajewala Waterworks. We covered the distance faster as we had left the hilly roads behind. At the nearest town we saw a market where the wood was being sold. We now understood the sad story of these logs.

Familiar trees came our way. Eucalyptus, silk cotton, shisham, laburnum etc. We spent a night at Yamuna Nagar. Small and large industries dotted the place. There were no forests. A six hour drive on the plains got us back to Delhi the next day.

- *Each tiger has its own home range or territory. Those of females (tigresses) are about 20 sq.km in area, while male territories range from 60 to 100 sq.km. A male's territory does not overlap that of any other male, although it includes the territories of several females. The tiger regularly patrols the borders of its home range. Tigers work hard for their meals. Studies show that only one stalk in twelve or fifteen is successful.*

- *When snakes feed, the meal is nearly always large compared with the size of the mouth. Food is always swallowed whole. A snake has an amazingly flexible skull and jaws, that can be 'walked' around the prey.*

  In zoos, snakes are known to often refuse food for considerable periods, without any ill effect. Such a fast can last over two years!

THE YAMUNA AT DELHI

When the Yamuna touches Delhi and flows through the city, its banks reflect the results of urbanization and of an ever growing population. Shanties, slum areas, hundreds of houses, industrial units, cremation grounds, sewage treatment plants, power houses and all the other paraphernalia that go with a city crowd the banks of the river.

The original natural scene that was here even a few decades ago has changed. Few fields now remain and the green areas are limited to the Rajghat stretch and the Kalindi Kunj areas which have been developed into beautiful parks.

Thousands of choice trees cover the area opposite the Red Fort from Rajghat to Vijayghat. Kalindi Kunj area which is near the Okhla barrage, was once unkempt, unused land. It has been made into a park with undulating green lawns spotted with clusters of trees and flowering shrubs. Unfortunately, well kept and beautiful pruned gardens do not encourage an undergrowth of plants around shrubs and trees, nor the mix of plants that is there in nature. Therefore we do not find a variety of plants, insects, birds and small animal life in man-made parks.

MINI FIELD
I'm magnified!
Hi!

Activity

A SHARING WALK AND A MINIFIELD

Carry out a silent sharing walk down your riverfront. Walk in silence, in a small group. The silence and harmony of this activity, especially at dawn or dusk, creates an awareness that we are sharing the world with all living things. A silent sharing walk, coupled with keen observation has tremendous potential.

The first thing that you notice when you walk along the river will be the vegetation. Some plants grow on the banks, while others grow under the water. Some plants have their roots in water but their leaves and flowers are out of the water (eg. lotus). All these flowering plants are very specific to the climate and habitat in which they thrive and they do not grow in other habitats.

A variety of flying insects and crawling insects are found in and around fresh water. In each season you will notice many different species. Frogs, insects, fish and birds all of which are very specific to your own waterfront.

During your walk, in groups of two, choose a piece of ground on your riverfront, which for some reason looks interesting to you. It need not be of uniform appearance.

Mark your MINIFIELD with sticks, string and stones and map it out on a large chart paper. You will notice various kinds of plants, objects, stones, holes, seeds, fruits, seedlings, animal droppings, peels and other bits and pieces.

You will observe things on your field that are either still and stationary, like stones, dead leaves etc, while others are crawling around, like insects. Tiny creatures may be burrowing in the earth, while plant life may be growing on your patch of land. Note down and map all your observations on your minifield chart.

Also you can pull a net slowly through the water, along the bank of your minifield, and empty the contents into a bowl. Look at each item carefully. Take a magnifying glass, so that you can look at very small creatures. Make a note of everything you find. Then carefully return the contents of your bowl to the river.

It can be very interesting to collect a small bit of frog spawn and keep it in a large bottle full of water in your classroom. You can see the tadpoles develop into froglets. But, always remember, however, to return the froglets to the river side from where you collected the spawn. They too have to go home!

Try and see if you can find relationships between any of those things, (dead or alive) that you find in your minifield: relationship between things of one kind or of different kinds. Also between plants and animals and people. If you look further, you can find connections between life in your minifield and life in the larger river front area. This could be in the form of insects crawling through your field. Where did they come from and where are they going? Or maybe you can find the parent plants of the seeds/seedlings you have in your area. Carry out the same activity with leaves blown into your field - try to find out from which tree and from where they came.

This activity will illustrate how everything is interrelated in nature which means that you cannot study your minifield in isolation.

Write down both what you find and also what you think about during your observations. You may draw, or sketch, or paint to make it clearer.

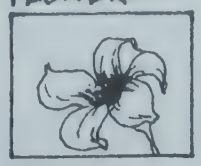
Later, you can talk about it, with each group participating in a discussion and sharing their observations.

Present the findings of your minifield in a huge collage. Your collage can have your own sketches, photographs and pictures (from a book or a magazine) of the animals, insects, plants, flowers and trees of your minifield. A multi-media collage!

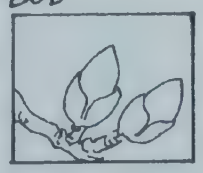
Add a dried flower/leaf, rubbings of barks, dried insects, flat stones, a poem on your tree/flower, sentences and words written in calligraphy..... You can have a collage day in school where each group will display their collages. What a panoramic view of your river front! Or rather, a 'macrofield'!

TREE NEWS

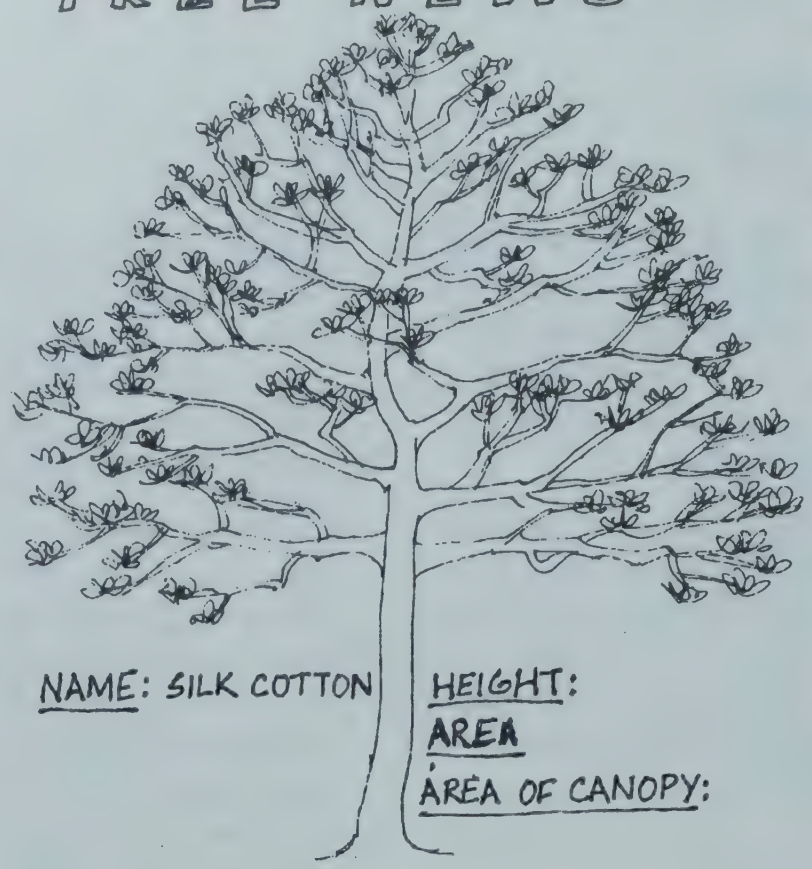
FLOWER



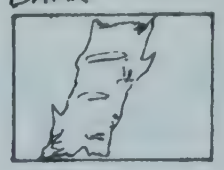
BUD



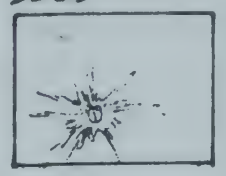
LEAF



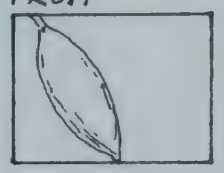
BARK



SEED



FRUIT



NAME: SILK COTTON

HEIGHT:

AREA

AREA OF CANOPY:

OTHER LIVING THINGS FOUND ON THE TREE

INSECTS _____

_____

BIRDS _____

_____

ANIMALS _____

_____

USES OF _____

THE TREE _____

Activity

A POEM AS LOVELY AS A TREE

If you do not have a tree in your minifield, choose one nearby. Make your own tree diary. Make a detailed study of your tree for a whole year. What kind of tree is it? You can also prepare an information sheet like the one given above and fill up details of the tree you have chosen.

Make drawings or paintings, or take photographs to show your tree in summer and winter. Write down as many measurements as you can for your tree: its height, girth and how far its branches spread. Collect bark, twigs, and leaves or leaf prints. Press a few of the tree's flowers and mount examples of its fruits or seeds. You can make bark rubbings by placing a piece of butter paper on the tree trunk and gently rubbing on it with a soft pencil or crayon.

What is the timber of the tree used for? Can you obtain a small piece of that kind of timber for your diary? A carpenter might be able to give you a piece.

Make lists or drawings of any birds, insects or other small animals you see on your tree. Write notes about their life histories. You may need nature encyclopedias for this or discuss it with your teacher.

Either refer to books or ask people about the uses of the tree. Two or three students can study one tree. A large variety of trees will be studied in this way. When all the sheets are ready, display them on the wall of your class room, so that each individual can learn about all the other trees on their river front.

Heartbeat of A Tree

"A tree is a living creature. It eats, rests, breathes and circulates its 'blood' much as we do. The heartbeat of a tree is a wonderful crackling, gurgling flow of life. The best time to hear the forest heartbeat is in early spring, when the trees send first surges of sap upward to their branches, preparing them for another season of growth.
Choose a tree that is at least six inches in diameter and has thin bark. Deciduous trees are generally better for listening to than conifers, and certain individuals of a species may have a louder heartbeat than others. Press a stethoscope firmly against the tree, keeping it motionless so as not to make interfering noises. You may have to try several different places on the tree trunk before you find a good listening spot. You will be surprised at the rhythmic sounds you will hear!
You will want to hear your own heartbeat from the same stethoscope. Listen also to the heartbeats of mammals and birds - the variety in sounds and rhythms is fascinating."

from Sharing Nature with Children
by Joseph Cornell

Activity

Identification Game:
Do you know the names of trees?

As you explore the river front while working on your minifield and the tree activity, collect small samples of leaves, flowers and seeds from the trees and bushes. You'll need about 7-10 specimens in all depending on the number of players.

Form two equal teams and line them up facing each other, 30 feet apart. Put the plant specimens in a row on the ground between the two teams. The teams count off separately, so that each player has a number, and in each team there are players numbered one, two, three, etc.

When the teams are ready, call out the name of a tree or bush represented by one of the specimens lying between the teams, then call out a number. (To add surprise, call the numbers out of sequence). For example, the supervisor says,

"The next plant is a neem tree, and the number is.... three!?"

As soon as the 'threes' hear their number called, they race to the specimens, trying to be first to find the neem twig/leaf. Every successful player earns two points for his team. Picking up the wrong specimen results in a loss of two points!

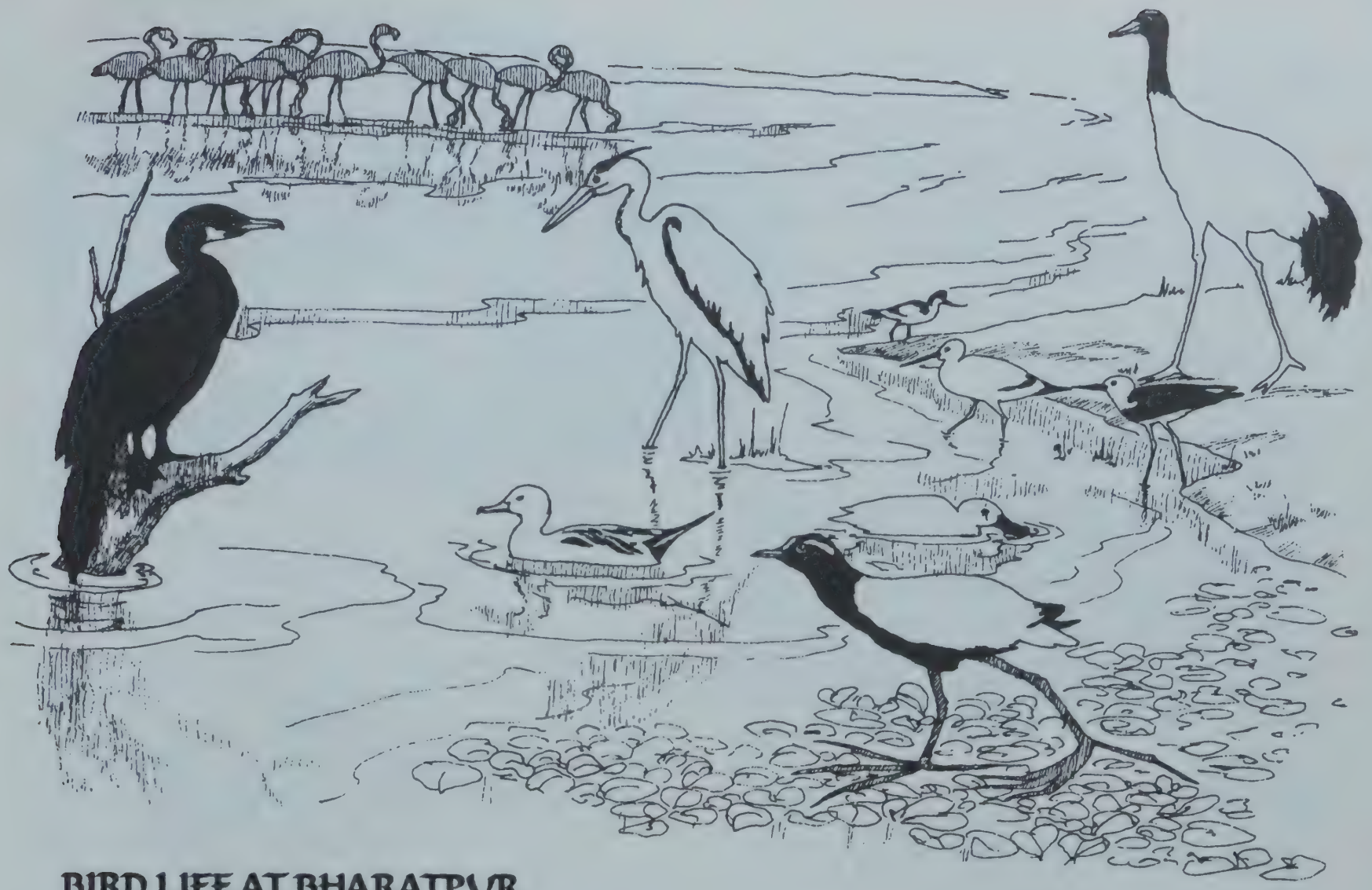
Activity

BIRD CALLING ON YOUR RIVER FRONT

Introduce yourself to the fascinating world of ornithology, or birdwatching and what better place to start than your own river front? Bird identification takes time, and is a matter of practice and field exposure. Just keep your eyes and ears open and you will begin to recognise many, many more species than you ever thought you could. To study a bird you will have to take into account its size, colour, shape of beak, tail, feet, feeding and nesting habits. Listen for the 'calls' and try to understand the bird's seasonal cycle .

"Bird watchers ('birders') have traditionally been thought of as eccentric types who trudge about the woods and climb trees with unruly collections of notebooks, binoculars and cameras. But if you ever get a chance to observe birds closely, you'll discover that they're beautiful to see and listen to, and utterly fascinating in their habits. You may find yourself not only understanding the 'birders' obsession, but catching it yourself!
In the bird world you'll find exquisite beauty and almost unimaginable homeliness; perfect grace and total clumsiness; fearsome power and gentle humility; silent soaring in rarified heights, and earthy cackling and squabbling.
One evening I put on old pants and shoes and walked out to my favorite marsh. As I neared the marsh around dusk, I was startled by a thunderous roar. Thousands of geese trembled together in a huge flock, flapping hard to build momentum for take off... then erupted, covering the sky with their bodies. And skimming over the cattails out ahead were countless flocks of ducks, criss-crossing in every direction."

from Sharing Nature with Children
by Joseph Cornell



BIRD LIFE AT BHARATPUR

Come January and the Keoladeo Ghana National Park comes alive with the visit of the famous Siberian crane and other beautiful birds like herons, egrets, ibis, spoon bills, storks etc., from the Northern Hemisphere.

This freshwater marsh is today famous the world over as a home for migratory birds. The main source of water to the park is a temporary reservoir Ajanbund, which receives its supply from the Gambhir and Banganga rivers. A system of earthern dykes and sluice gates regulate the water within the park. By spring most of the water that enters the park after the monsoons evaporates leaving behind only a few small pools.

Three hundred and twenty two bird species have been recorded who migrate thousands of kilometers to this winter home for nesting and breeding.

While visiting the Bharatpur National Park it is a thrilling and emotional experience to witness the first rays of the sun, when all the birds awake. The sky is full of birds flying about and the noise levels is startling, as they all say good morning to each other!! The visitor has to be still and remain quiet to witness this sight. Gradually the birds settle down and one can move around slowly using binoculars. Wading in the marsh yields rewarding bird watching.

Sadly, all over the world, the resting and nesting places of birds are being increasingly degraded and several species, especially migratory birds are being endangered.

Bird migration still defies scientists. We know that flocks of birds move out in search of food and breeding grounds owing to temperature and seasonal changes. But what is the system of navigation that makes birds find their winter homes? Every year the birds return to the same sites. Some fly by day, others by night while some fly non-stop. Ornithologists are still trying to get answers. They ring birds or attach mini satellites to them to gain knowledge about their life patterns.

DID YOU KNOW

- The kingfisher lays its eggs on a bed of fishbones - at the end of a metre long tunnel in the river bank.
- Dragonflies are part of the intricate, hidden food web that thrive in water. Dragon flies feed on the smaller insects, who in turn feed on the harmful bacteria present in the water and rid the water body of such organisms.

Activity

MAKE A SET OF PLAYING CARDS BASED ON NATURE

Instead of the usual suits i.e. spades, diamonds, hearts and clubs, think-up four 'natural' suits.

Eg - trees
birds
plants/flowers
animals/insects

Like the usual card pack, each suit should consist of 13 cards.

Each card in each suit should have a picture of a different tree, bird, small plant/flower or animal/insect. This way you will get sketches/pictures of 13 trees, 13 birds, 13 animals/insects, 13 plants/flowers. Include many from your own river front. You may add some from your school or home neighbourhood environment, so that you are familiar with each card you design.

Each of the 13 cards in a suit must have a value, which will also be the number of the card.

Eg. Camel=13, Monkey=4, Squirrel=1, etc.

This number should be clearly marked on the card along with the picture.

Using these cards a game based on 'rummy' can be developed and played.

At the end of a few games, each player will be familiar with many trees, birds, plants and animals.

Having made this pack of cards with suits from the world of flora and fauna, think of other card games that can be played by four or more players.

Activity

DEBATE RIO AND RIO PLUS 5 IN YOUR CLASS ROOM

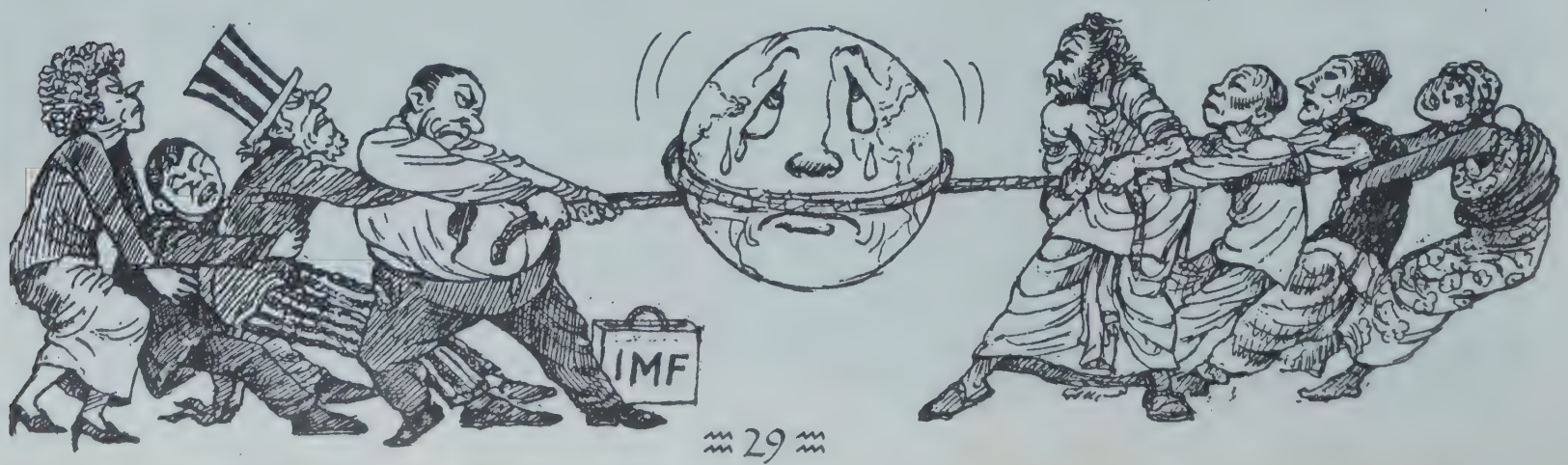
In 1992 there was the 'Earth Summit' at Rio de Janeiro in Brazil. Many discussions were held about the danger to our natural environment and how it can be averted. Look for those old magazines, newspapers etc and collect relevant 'clippings'. Prepare a wall magazine highlighting the news. Give a gist of the important decisions made.

Compare and contrast the 'Earth Summit' at Rio in 1992 with the latest 'Earth Summit' held at the UN in New York in 1997. This meet was called Rio plus 5. Collect all relevant materials available.

One of the leading newspapers had this to say in its editorial in 1997 :

'The UN earth summit has generated nothing more than a lot of hot air after days of wrangling over issues like global warming, the ozone layer and emission of greenhouse gases. In short, there has been little progress since the ambitious Rio summit which was considered the blue print for sustainable development.

The concluding remarks of the UN meet that 'we are deeply concerned that the overall trends are worse today than in 1992' without suggesting any concrete solutions indicates that this pattern will continue. The situation at present is alarming, more than 50,000 square miles of forests are being stripped of their green cover every day, greenhouse gases emission is at an all time high, and the number of people living on less than a dollar a day has risen to above 1.1 billion. This would not have happened had the two main initiatives taken at the Rio meet been tackled decisively—the first to cut fossil fuel emission and the other to protect biodiversity.'



The forest is on fire, Runaway O tiger;
The river is drying up, Run away O fish.

Men will kill you, Run fast O tiger;
Men will catch you, Run away O fish

From a folk song of the
'Munda^ tribals of Orissa

THE AMAZON RIVER AND ITS FLORA FAUNA

Just south of the equator in South America flows the world's mightiest river, the Amazon. The river's basin spreads over acres and acres of land that house the largest rain forest. Here, under the blazing sun, with very humid conditions, along with an abundance of water, we find a most fantastic and unique natural life.

If you see a film of the Amazon basin, with the camera placed in a plane flying slowly over this area, you will see vast expanses of thick dark green. The dominant feature is the great forest. This green cover is made up of thick vegetation as well as tall trees, that can be divided vertically into storeys or floors depending upon their height. The plant life is all tangled together, making it impossible for the sun's rays to penetrate through them. The great variety of species in the Amazon make this river basin perhaps the richest plant environment in the world. In certain areas within an area of 1.3 square km., one can find 117 different trees, with several varieties of shrubs, herbs and ferns adding to the variety.

The flora patterns range from swampy mangroves at sea level, thick humid rain forests, to oak and pine forests in the temperate zone bordering the foot hills of the Andes mountains, after which are found bush and scrub land plants upto an altitude of 10000 ft, from where the snow line of the Andes begins.

The most famous plants of the Amazon are the palms, the rubber tree, the cocoa tree, rosewood, thousands of species of orchids, the coffee tree and the famous quinine; flowers, ferns and lilies; along with the famous Brazil nut, the silk cotton, banana, pineapple and fig plants. No wonder the Amazon basin was plundered for its valuable 'economic' plants, and what a debt we owe to it for the many foods and medicines we use today.

Where there is such unique flora, the fauna will also be note worthy. In contrast to other regions of the world, a large percentage of the mammals are tree dwellers! None of them attack man unless provoked. Tapirs, deer, armadillos, tailed porcupines and opossums thrive in these humid forests along with predators like the jaguar. The monkeys are all arboreal and live high above the matted undergrowth. The great forest resounds with their morning and evening chorus.

Several species of squirrels, rodents, bats, frog, large snakes especially the famous green boa and the anaconda; turtles, dolphins and the dangerous cayman fish reside in the waters.

The Amazon area is inundated with countless varieties of insects. Ants, spiders, cockroaches, beetles, bees and butterflies along with a host of other insects are each found in hundreds of their kind in form and colour. Within an hour's walk in the rain forest, a researcher found 700 species of insects as compared to 321 species in the whole of Europe!

RAMSAR CONVENTION

To protect bird habitats the world over, the Waterfowl Habitat Covention, better known as the Ramsar Convention was adopted in 1971. India too is a signatory to this convention and is obligated to protect and conserve the ecology of wetlands especially those that are designated as Ramsar sites. In addition to the Keoladeo National Park which is also a World Heritage site, the Ramsar sites indentified in India are: Chilka Lake (Orissa), Wular Lake (Kashmir), Harike Lake (Punjab), Loktak Lake (Manipur), Sambar Lake (Rajasthan). You can imagine the rich reservoir of natural sites we have in our country.

Can you collect any information in the form of photographs, media articles, stories, poems, case studies on the life of the people/tribes who live in Keoladeo at Bharatpur and the other five lakes mentioned above in India?

Rivers of Kerala

Why are Kerala's rivers drying up and beginning to die? The answer lies in short sighted planning and activities such as indiscriminate deforestation,industrial effluents being poured into the waters, sand mining on the river banks, brick making, garbage dumping, plantations and dams. Huge forest areas look shaven with skeletal hills. Deep waters flowing through lush green vegetation are gradually becoming vast dry beds.

The lifestyles of the people of Kerala are closely connected with their waterways, what will happen to them when they might have to face the reality of their rivers facing extinction?

Malayalam literature is full of couplets such as, "Periyare Pariyare Parvatha nirayile panineere Kulirum konde kunungi nadakhanna."

Translation:
The poet is invoking river 'Periyar'. He says that the river is like nectar or 'rose water' flowing down the mountain ranges.

Forty one of Kerala's forty four rivers flow westward from the Western Ghats to the Arabian Sea. This large network of rivers nourish India's last tropical rain forest environment.

In tropical rain forests the immense quantity of rain water filters into the earth creating large reserves of groundwater, which in turn, feed the numerous brooks and streams that maintain the flow of water in large rivers throughout the year. However, denuded hills and decimated forests do not help in maintaining these water catchment areas, resulting in soil erosion, weak water flow and often floods, when the rainfall is only a little more than normal. "When a forest is depleted from the upper reaches of a river and sand is removed from the lower reaches, there is no need to have any additional reason for the death of a river," says Narasimha Prasad of the Centre for Water Resources Development and Management at Kozhikode.

As mentioned in the newspaper report given below the Bharathapuzha, one of the State's longest rivers is today its biggest catastrophe. Forests have been destroyed in the river's catchment areas, resulting in the disappearance of all its perennial streams. Today the river is a dry sand bed benefitting thousands of truck loads everyday. Sand mining served the overwhelming needs of the construction industry in the 1980's.

> 'The unending large scale collection of sand from Kerala's most important river Bharathapuzha is damaging it tremendously. Most of the forty rivers of Kerala have been affected in this way. Trucks can be seen stationed on river beds everywhere - labourers fill the truck with 10-12 tonnes of sand in one trip. At many places work goes on around the clock. The right to gather sand and transport it, is auctioned off every year by panchayats. Much of this sand goes to Tamil Nadu where there are strict rules on removal of sand, and hectic construction activity.'
>
> Hindustan Times, 1994

Laws remain on paper while parcelling out contracts on the river for sand mining. Today sand mining is done in nine major rivers. From the Pamba river alone, 2000 truckloads of sand are lifted daily, from 20 different points along its course!

When sand is removed, the downward slope of a river

bed increases. As a result, the water flows faster and this reduces the capacity of a river to recharge ground water. People living near the Pamba river and other rivers of Kerala today, do not get sufficient water for agriculture!

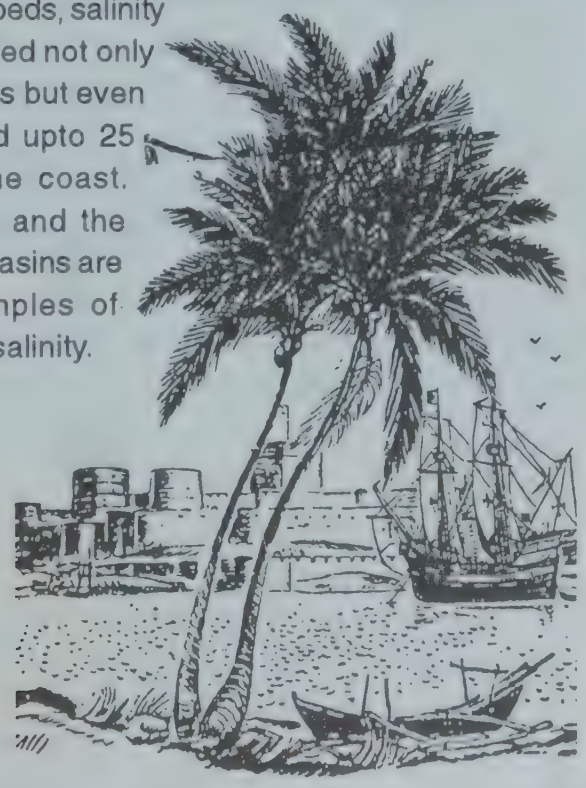
Another fallout of sand mining is the 'sinking' of the river bed. Many drinking water schemes and filtration tanks of towns and villages now stand above the water level! When water levels fall during the summer, this results in no drinking water during the hot months.

Villagers living on the banks of the Neyyar desperately seek water for drinking and farming, as saline sea water has entered the depleted groundwater table here. This also affects the river's water.

The dug up river bed of the Pamba river creates an uneven track for the famous snake - boat race at Onam, resulting in tragedy when rival groups clash. This river is also alarmingly contaminated with more than ten water borne diseases, largely due to the millions of devotees who visit the Sabrimala shrine. The introduction of bacteria on such a large scale is way beyond the river's self purification ability.

Illicit brick kilns have mushroomed along the Bharathapuzha, Neyyar, Kallada and Periyar rivers. Even though this industry gives employment to many labourers, it has begun to eat into the banks of the rivers, depriving the very same people of their food from paddy fields that are disappearing. This is because brick kilns drain the water. Lack of water is also affecting the yield of many other crops such as coconut and spices. Ponds of mud and stagnating water are beginning to form wherever the river banks are disappearing. A few years of continuous brickmaking can mutilate the river, turning it into a series of shapeless mud pools.

Besides this, studies reveal that due to the sinking of Kerala's river beds, salinity has encroached not only the same beds but even the hinterland upto 25 kms. from the coast. The Cheliyar and the Pamba river basins are glaring examples of encroaching salinity.



Activity

THE ACTIVITY TRAIL

An activity trail is designed to lead people step by step, very much like a treasure-hunt game, to a number of pre-determined places in the immediate surroundings. Brief route instructions have to be devised in the shape of a map or number indications.

At each place, the participants are presented with some 'action' challenge, through a paper drawn up beforehand with an interesting activity written up in a few words and distributed to each group.

The answers to the question must be obtained by some activity to be carried out on the spot. The activities given on the paper can be a careful observation, or a measurement, the carrying out a simple experiment, or a short discussion. After visiting a number of places, each group can share their findings and experiences. This activity trail can be set up in any environment.

Remember to have one linking theme given to each group during this activity trail. In this way the groups will cover a variety of themes/areas, and therefore group sharing will be both informative and fun.

CASE STUDY:

THE CHELIYAR RIVER-CALICUT

What does a terene pin stripe suiting material have in common with Calicut's Cheliyar river?

The GRASIM factory manufacturing the 'man-made' yarn that spins these suitings, spews effluent into the Cheliyar, as it stands on the banks of this river at Mavoor, a suburb of Calicut.

One of the main raw materials for the plant is wood-pulp. Yes - you are correct! Initially it was got from the nearby forest cover, now denuded hillsides are 'planted' with mono-culture species that "feed" the plant. The factory is huge with frightening looking furnaces and chimneys that reach out to the sky. The river flowing in front of this monstrous structure is "dammed" from where fresh water is pumped up for the manufacturing process. Huge pipes from the factory pour out the waste water downstream. This river water then reaches the town of Calicut.

Of course there are now new effluent treatment plants (that were put in after many citizen's protests), but they work as and when...?

One can see coco-cola coloured, foul smelling effluent being poured into nearby paddy fields. The health hazards to the agricultural labour are many and the quality of rice that feeds millions is affected.

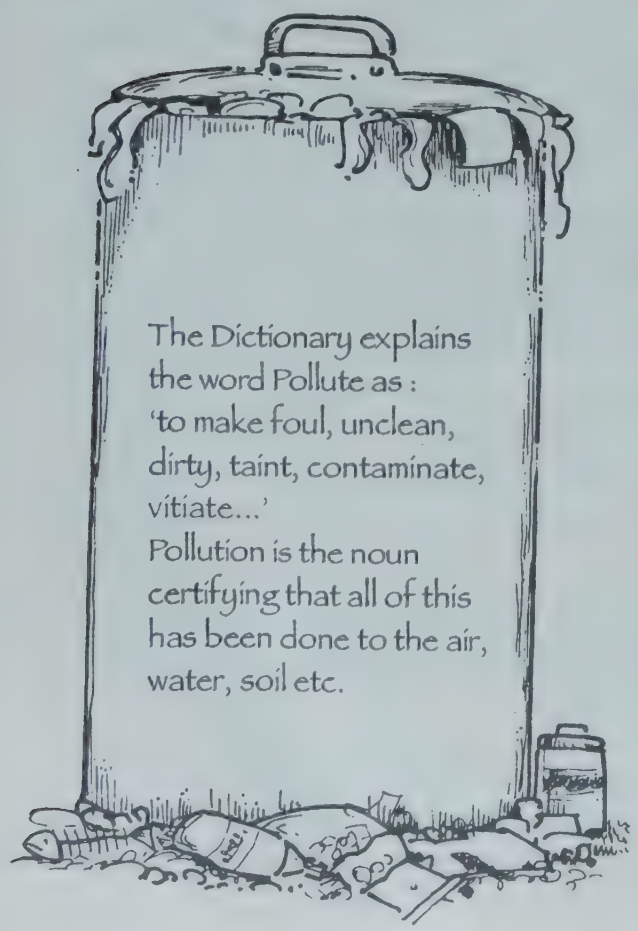
Pollution

"Die-meisten fliissee sind kloaken"
(most of the rivers are sewers)

Headline in Berliner
Morgenpost - a German newspaper.

From time immemorial people have prayed on the banks of the river Yamuna. They have worshipped its waters and have been witness to many religious events.

When the Mughals built the new city of Shahjahanabad on the Yamuna, its water was clear and sparkling, and the poets called it the 'Blue River'. Now, barely a few centuries later, the Yamuna has gained the reputation of being the dirtiest and most polluted river in our country. Environmentalists and scientists are concerned at the high level of pollution in the river. Discussions are being held and high powered committees being set up, to formulate a plan to clean the Yamuna.


The Dictionary explains the word Pollute as :
'to make foul, unclean, dirty, taint, contaminate, vitiate...'
Pollution is the noun certifying that all of this has been done to the air, water, soil etc.

WHO IS RESPONSIBLE FOR THIS POLLUTION WITHIN DELHI ?

- Five million people who live in the city but have no access to proper facilities, use open drains as **toilets**. These drains flow straight into the river, adding to its pollution.
- **Thermal and electric power stations.** The Indraprastha power plant discharges untreated effluent into the Yamuna. There is a legal case against them for not setting up effluent treatment plants.
- **Pesticides** used for agriculture from fields on the river bank and further upstream.
- **Factories** pouring out chemical discharge both in Delhi and upstream.
- Slowing down of the flow of water due to **construction of bridges and dams,** resulting in the quick growth of water hyacinths and other undesirable plants.
- Harsh **soaps and bleaches** used by dhobis while washing clothes along the banks of the river. A change in soaps and the introduction of chemical detergents has not only had an impact on this age old trade, but also on the level of pollution in the river.
- About 80% of the water supplied to Delhi is returned to the river as waste. Of this water 50% is **untreated** and contaminated despite the fact that Delhi has five **sewage** treatment plants. Most of these do not function to their maximum capacity. As a result only half the sewage is treated before being dumped into the river.
- **Slums** that have come up on the banks of the river and people living here use the river for bathing, washing clothes, as toilets and as open dustbins.

And on flows the dirty Yamuna

104.B12.6.

By ANIL SAXENA

NEW DELHI, November 21.

PAUCITY of funds has hit the various sewerage schemes in Delhi rendering it an almost uphill task to make the Yamuna pollution-free.

Though the authorities claim that a reduction of 13.5 per cent of pollutional load has been obtained ... 1982-83 and 40 per cent ... 1985, it is doubtful ... have a clear ... the ...

Delhi's river of sorrow

... conducted by ... the Prevention ... of Water Pollution the ... quality of water in the river below Wazirabad Barrage to upstream of Okhla Barrage is "bad". It is "ordinary" downstream of Delhi (below Okhla Barrage to Agra) and "good" from Hathnikund to upstream of Delhi (above Wazirabad Barrage) and downstream of Agra to Allahabad.

In Delhi, the main reason for the flow of sullage into the Yamuna through the storm water ... absence of a ...

... the existing sewerage system due to its inadequacy or damage to the sewer lines and absence of trunk or outfall sewers in some of the far-flung colonies recently developed ... significantly contribute ... sewage into the ... untim...

... ...ent and J.J. ... without a sew...

...According to the study, of the 17 drains polluting the Yamuna, the Najafgarh and Barapulla drains are the worst, dumping 64.5 and 28.0 million gal... riv... by do... tri... oxy... emical demand) load from these drains is 150 tons per day, dissolved solids 300 tonnes per day and suspended solids 150 tonnes per day.

Out of the total 17 ... seven drai...

The present water ... 397 mgd ... augme... Delhi is to be about ... comes ... water. With ...age treatment ca... ...ay being 152 mgd, the ...uance finds its way into the river.

According to the chairman of the Delhi Water Supply and Sewage Disposal Undertaking, Mr Ramji Lal, the undertaking in order to make up the backlog has chalked out a programme which claims to aim at augmenting the sewerage facilities and sewage ...

In addition to this, about 12 mg... sewage is treated through oxidatio... ponds near Timarpur. Work is also i... progress in respect of augmentation ... sewage treatment capacity by 102 mg... which is scheduled to be completed b... 1988.

Inspite of the facility of getting sew... erage connection by paying 10 p... cent of the estimated cost as develo... ment charges before the work is take... up and the balance in eight equ... instalments, the public response fro... regularised and unauthorised coloni... is poor. There are 452 regularised a...

The endangered Yamuna

The capital turns its sacred river Yamu... into a sewer

It is claimed that during the last four to five years sullage ... nullahs ... e ...

... jurisdiction of the MCD have be... regularised and 52 colonies do ... qualify for regularisation. While wa... supply facility has been provided ... 226 colonies so far, internal sew... have been laid only in 73.

It is feared that with so much w... remaining to be done a pollution-f... Yamuna may always remain a dist... dream.

Pollution in Delhi—II

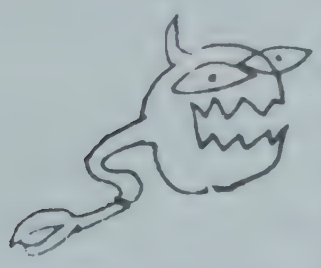
THE HINDUSTAN TIMES WEEKLY SUNDAY JANUARY 25

Industrial effluents poison Yamuna

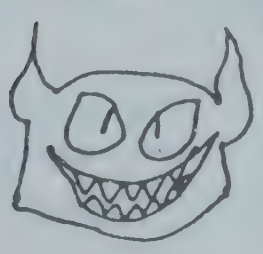
By Sardhan Jain

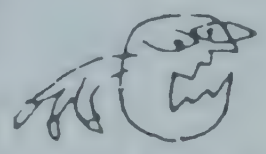
... awaited for connect to t...

Nature has a great capacity to cleanse the earth and its resources. Of course that is if man's intervention is small. In case of water, we have seen it gets polluted in many ways. The sun through its heat, is a prime factor for cleaning and purifying it. It converts water into vapour, the clouds so formed, condense to enable clean water to come down in the form of rain to replenish rivers and tanks. Sunlight also penetrates the river waters and helps the submerged plants to produce oxygen. Also the sun helps in the process of photosynthesis of floating water plants. Oxygen is again produced through this process. It is this oxygen level prevalent in a water body that ensures its purity. When sunlight is no longer able to penetrate the water, the plants begin to die and therefore oxygen gets depleted.



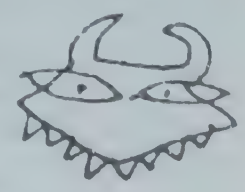
Plants like water hyacinths and some weeds absorb toxic wastes from the water body and also produce oxygen. But, water hyacinths do not allow the sunlight to penetrate and they also gradually begin to prevent the flow of water, causing stagnation. The two factors have strong damaging consequences that undermine the fact that hyacinths produce oxygen for the water body. Water bodies contain suspended and dissolved solids besides germs. All waste falling into a river adds to the total solids in the water body. This increases the turbidity and reduces the sun's penetration, countering the beneficial effects of the sun.





The germs present in the water feed on the waste that falls into a river. Aerobic germs are those that live on oxygen found in the water and are found in the upper levels of a river. As there is only a certain quantity of oxygen in the water, the aerobic germs deplete it in order to digest the dirt, when the waste matter increases in the river. As the oxygen level falls and when it is no longer available, aerobic germs begin to die in the river.

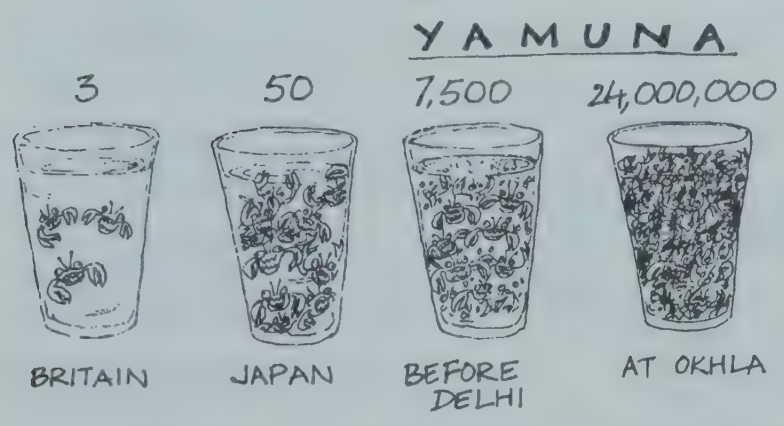
At this stage the aneorobic germs, those that do not need oxygen for their survival, rise from the deep bed of the river and absorb the waste with the help of hydrogen. The hydrogen mixes with the sulphur of the waste matters and produces hydrogen-sulphide gas which further pollutes the waters.



HOW SAFE IS THE WATER YOU DRINK ?

Drinking water should be completely free of coliform bacteria. These germs cause stomach cramps, diarrhoea leading to dehydration and even death. This means water should contain a minimum of germs present in 100 ml water.

For every 100 ml



THE RIVER IS POLLUTED THE YAMUNA IS DYING

But this is only one example, here are many more....

PERIYAR is one of the enchanting rivers of Kerala. On the banks of this river is the factory of Indian Rare Earths. This industry has hazardous effluents with dangerous radioactive components that have been seeping into the waters of the Periyar.

TUNGABHADRA river in Karnataka has two chemical factories situated on the banks which discharge effluent such as mercury and zinc.

CAUVERY river in Karnataka reveals metal pollution and in Tamil Nadu it continues to receive industrial wastes.

GODAVARI in Andhra Pradesh receives 4,500 gallons of toxic waste everyday.

DAMODAR AND HOOGHLY in West Bengal receive waste from coal washeries, steel smelts, chemical industries, distilleries, pulp and paper mills.

GANGA : Although a sacred river is far from being clean. People wash clothes and bathe on its ghats: half-burnt and unburnt bodies are thrown into it. Human defecation on the banks, washing and tethering cattle on ghats

THE YAMUNA IN DELHI EXCEEDS ALL LIMITS

" The Yamuna water at Delhi has been graded 'bad' for bathing and public water supply. Choked sewers and inadequate sewage systems, ever increasing piles of dump, industrial effluent might well prove to be Delhi's nemesis by the 21st century"

1994 First City Magazine:

Why is the Yamuna Unable to Clean Herself ?

From its entry to Delhi at Wazirabad to its exit at Okhla, the river Yamuna is fed by 17 major drains in Delhi. It receives tonnes of untreated industrial waste, domestic waste including toxic materials like arsenic, lead, zinc, cadmium, flouride, sulphuric acid so much is the load of the wastes, along with pesticide run offs and industrial effluents from upstream, that the Yamuna finds herself choked to death with the filth which is poured into her. The pollution is almost unbelievable. At Okhla the water is of grade 'E' quality. This means it is not fit for even irrigation. Bathing in or drinking these waters is unthinkable!

and the disposal of untreated sewage, pesticides from the fields and releasing industrial effluents into the river have made it a very polluted river.

VAIGAI river in Madurai in Tamil Nadu faces similar problems. The life line of tens of thousands of people who live by this river is threatened, as it receives the run off and effluents from the heavily populated city of Madurai. Vaigai is now turning into one of India's major garbage dumps.

KALU river flows through the industrial towns of Bombay, Ambarnath and Ulhasnagar. Poisonous chemical wastes flow into the river at Ambivale village situated on the river banks, and as a result the level of mercury in the river has crossed the danger mark.

Grass growing on the banks of the river absorbs the mercury. The cows grazing on this grass take in the mercury, which passes into the milk and affects babies drinking the milk. Environmentalists call it the 'mercury milk'.

Symptoms of mercury poisoning reminiscent of "Minamata", are also appearing on the faces of those who eat fish from this river and from vegetables grown nearby.

Activity

READ AND DISCUSS

What is your reaction to the information given below? Find out from your parents, friends and relatives what they feel about these three newspaper clippings. Share your findings through a lively group discussion.

HINDUSTAN TIMES 26.12.86
News Item

More than 800 kg of milk were poured into the Yamuna today amidst chanting of mantras in a religious ceremony, led by Swami Bhaskaranand Paramhansa at Ghat no 23. It was organized by the Akhil Bharatiya Yog Prachar Sangh. The Swami is said to have declared that he will perform Abhisheik in the Yamuna for 12 years to cleanse the river of pollution. This was the fourth time such a large quantity of milk was poured into the river, states a press note.

INDIAN EXPRESS 30.12.86
Letter to the Editor
Milk Cleanse

Sir , I was shocked to see the report that 21 maunds of milk had been poured into the Yamuna to "clean" the river. (IE Dec 26)

In a country where thousands of children die of malnutrition daily, there can be no bigger crime than this waste in the name of religion, or is it politics? Couldn't our secular Govt stop this wanton waste of food? Apart from wasting food this pouring of milk literally down the drain actually added to the pollution more than, say human excreta. Crores are spent to clean Yamuna and the Ganga. The Department of Environment should have tried to enlighten people about such superstitious rituals.

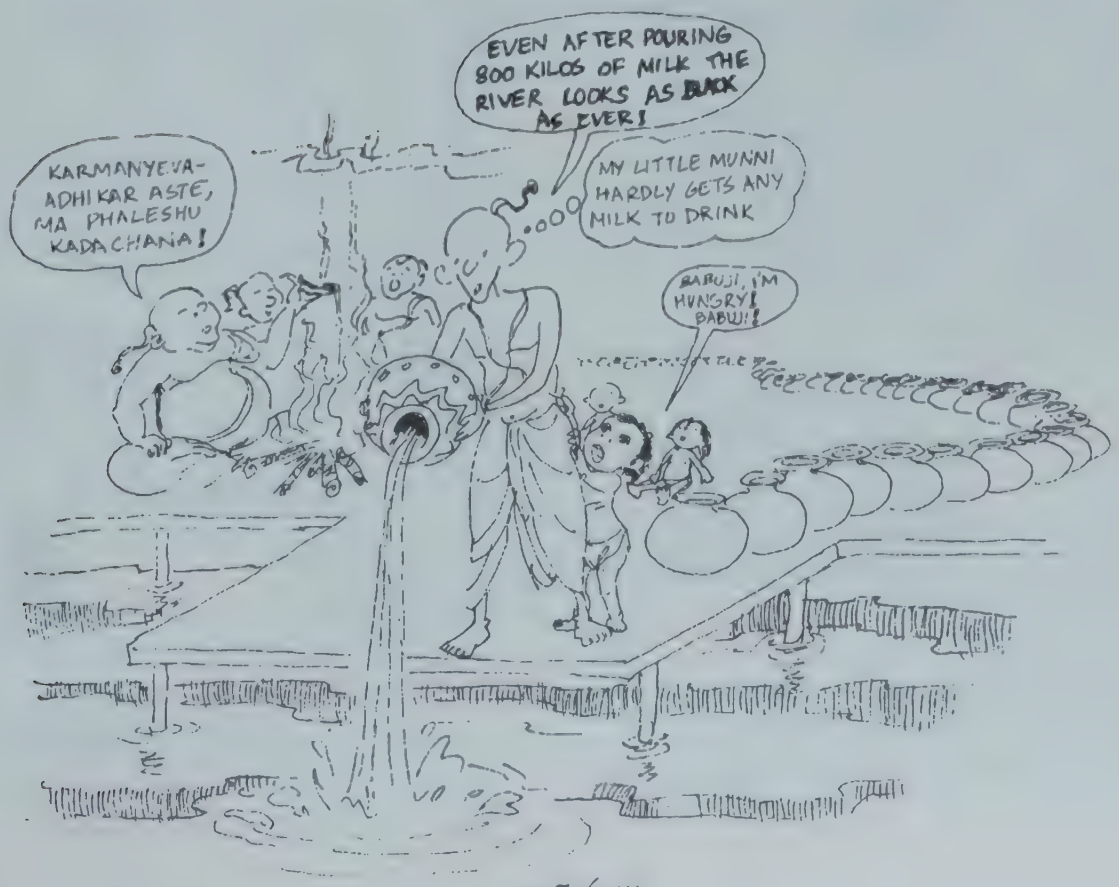
N KUNJU
42-B Pocket-I Mayur Vihar

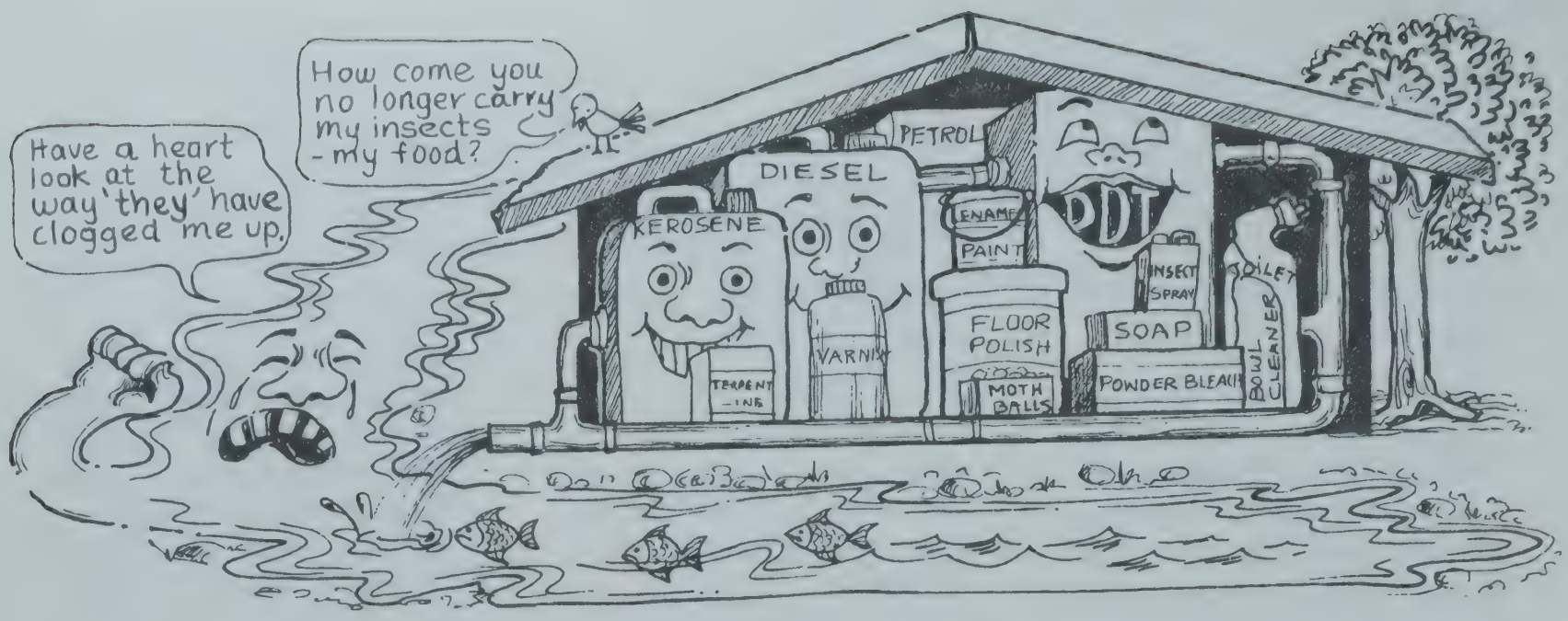
THE HINDU, 28.02.95

In a lecture at Madurai recently, it was made known that a survey of pollution in the river Vaigai had been conducted and it revealed that if allowed, unchecked pollution would soon make the river resemble the Cooum in Madras.

The river is the principal source of water supply to Madurai city. At various places along its banks, people launder clothes, bathe and use the water for religious purposes. The river receives the run-off and effluents from the thickly populated Madurai city.

In Madurai city, the river is an eyesore. While the Corporation provides 14 million gallons of water a day to the residents, untreated raw river water is also used for drinking by people, especially living outside the city limits. During the 'Chitrai' festival (April-May) the river is a focus of religious and recreational activity.


EVEN AFTER POURING 800 KILOS OF MILK THE RIVER LOOKS AS BLACK AS EVER!
KARMANYEVA-ADHIKAR ASTE, MA PHALESHU KADACHANA!
MY LITTLE MUNNI HARDLY GETS ANY MILK TO DRINK
BABUJI, I'M HUNGRY! BABUJI!



WHAT ARE HAZARDOUS HOUSEHOLD WASTES?

WASTE is anything somebody wants to get rid off. Don't forget though that something you don't want could be useful to someone else.

HAZARDOUS means dangerous. A hazardous substance is one which is likely to cause harm to the environment or to human health because of a relatively high degree of risk due to toxicity, reactivity etc.

HOUSEHOLD WASTE is waste from the household from products used in homes, gardens, cars and scooters.

So **HAZARDOUS HOUSEHOLD WASTES** are hazardous substances that households want to get rid of.

TOXIC means poisonous. A poison is something that causes illness, injury or death to any living organism.

TOXICITY means the degree to which a substance is poisonous. So every substance has some level of toxicity. Many foods which are grown with organic fertilisers, are virtually non-toxic - they have, for all intents and purposes, zero toxicity. Other substances are so poisonous that a single taste can be deadly. Arsenic is one example. Alcohol, aspirins, detergents, insect repellants, drain cleaners have different levels of toxicity.

Hazardous household wastes can be found in many places in your home. Look at the illustration above for some indicators.

All of us who use these products know how beneficial they are. But they might also harm us, or others!

Activity

DANGER IN THE DUSTBIN

I Look around your house and add more items to the list.

II Read labels of items and find out what chemicals they contain.(eg. Flit, drain cleaners)

III Check the toxicity of these.

Without realising it you are also responsible for polluting your river. Different commodities that are used in our houses, cause pollution when disposed of, or when they are used in excess.

BLAZING WATER

Can rivers catch fire ?

Cleveland, Ohio is one of the U.S.A.'s leading industrial cities. Through it flows the Cuyahoga River, into which factories have poured their wastes for many years. The river did actually catch fire in 1969 and is now so polluted, that it is classified a fire hazard!

Activity

SIMULATE A POLLUTED RIVER

What is needed

- ❑ open space
- ❑ thick white plastic sheet, 4 m.long
- ❑ mud, grease, oil, ash, different coloured water made by adding poster paints.
- ❑ mugs/jugs

In an open area of your school, dig a long shallow gully to represent the river and place the white plastic sheet on it. The end of the plastic sheet should be put in a large tub placed at a lower level.

Dig small gullies on either side of "this river" to represent the various drains that enter the river with waste and sewage.

Your "river" should look somewhat like the illustration below.

Now, dig as many gullies as the number of 'toxic materials' in the form of different coloured water you have been able to collect.

Two members should stand at the beginning of the "river" with large jugs of clean water. There should be one group member standing at the head of each gully, with a toxic material in the form of a coloured water.

Let the members holding the jugs of clean water, start pouring it down the "river" and continue the process, till the experiment is over.

As the water is being poured, the other members should begin pouring their toxic effluents like coloured water, mud, ash, grease/oil etc into their tributaries/nullahs of the "river".

Write down your observations as these 'wastes' come into contact with the water. Is the colour changing? Also note the effect of each drain on your river !

After the experiment is over, share your observations with the other group members. You can express your feelings in the form of a poster.

WHAT ARE THE MEASURES NEEDED TO CLEAN ANY POLLUTED RIVER ?

This will include steps like :

- ★ increasing the capacity and efficiency of sewage disposal works.
- ★ checking the flow of industrial toxins into the river.
- ★ construction of sullage treatment plants for waste water disposal sense.
- ★ making pollution control equipment and other related sophisticated equipment available at a subsidized rate.
- ★ taking legal action, imposing fines and punishment wherever necessary.

The last five decades since independence have shown that pollution rises in geometrical progression. The efforts needed for eradicating this pollution also needs to rise in geometrical progression!!

• • •

Here is a riddle which has its origins in France which aptly describes this phenomena.

Imagine you own a pond on which water lily is growing. The lily plant doubles in size each day. If the lily were allowed to grow unchecked, it would completely cover the pond in 30 days, choking all other forms of life in the water. For a long time the lily plant seems small, and so you decide not to worry about cutting it back until it covers half the pond. On what day will that be?

On the twenty-ninth day, of course. You have one day to save your pond!

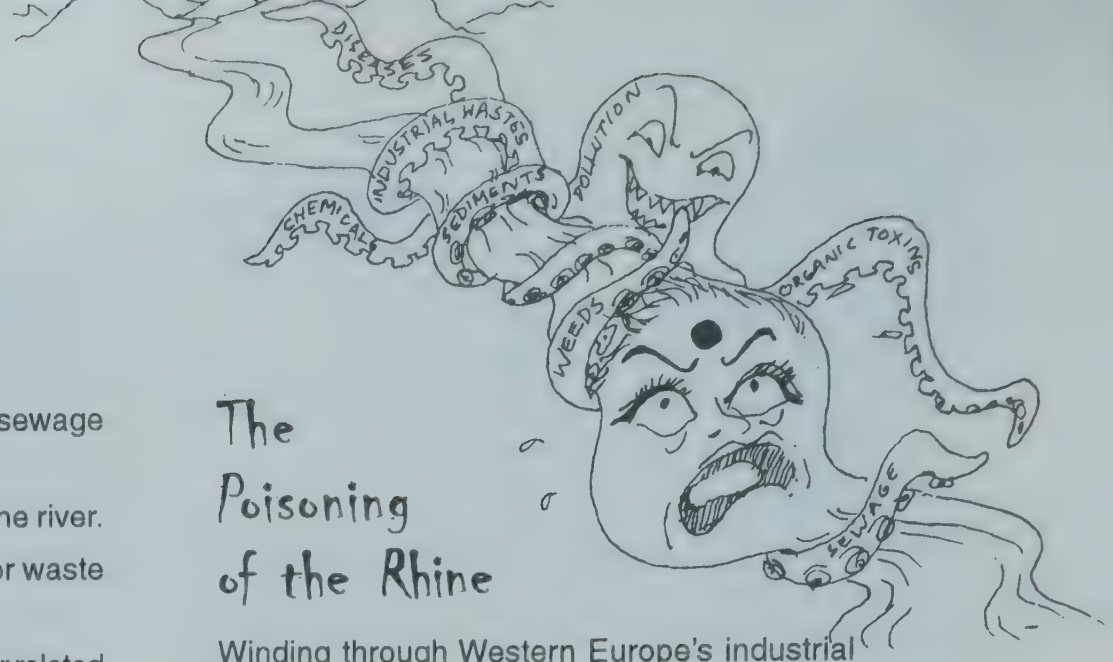
And maybe the same riddle applies to our rivers!

• • •

ACTION CAN BE TAKEN!

Talacauvery, the birthplace of the Cauvery is a major attraction for pilgrims. People from neighbouring states flock here throughout the year. But they also bring along with them flowers, puja items and food and cause excessive littering.

Under the Clean-up Kodagu Campaign, a programme aimed at cleaning the Coorg district in Karnataka, the school children of Coorg have taken up cleaning activities in Talacauvery and other pilgrim centres. Besides actually cleaning up the place by collecting the garbage, placing dustbins and posters at strategic places, the students also perform street plays to create environmental awareness among tourists.



The Poisoning of the Rhine

Winding through Western Europe's industrial heartland the Rhine waters are the most polluted anywhere, fouled by the hundreds of factories along its banks.

Though the river always seemed to take the punishment of receiving toxic chemicals from these factories, in 1986 the Rhine's own powers of self defence were overwhelmed. The reason: 30 tonnes of deadly chemical were washed into the Rhine from the Sandoz chemical plant near the Swiss city of Basel.

Vast stretches of the Rhine were transformed into a river of death. Along the upper 200 miles of the river, virtually all the living organisms big or small were wiped out. An estimated half a million fish including 150,000 eels perished. The 35 mile long reddish slick of lethal chemical flowed past France and West Germany heading for the Netherlands.

The lethal brew contained phosphorous based chemical products, pesticides and herbicides. It also contained ethyl parathion, a substance so deadly that it kills 50% of the people who absorb even small amounts.

In the aftermath of the disaster, some environmentalists charged that other companies were taking advantage of the river's chemical confusion to discharge some of their own waste substance. Scientists monitoring the river started to pick up toxins not associated with the Sandoz spill. The bitterest ironies of the Sandoz disaster lay in the fact that the Rhine had become a symbol of ecological revival.

Only in recent years residents of Basel have been able to go swimming in the river again. Where fifteen years ago, only three or four species of fish could survive in the Rhine, environmentalists had managed to reintroduce more than 10 varieties, amongst them the delicate trout. Most gratifying of all, the first of 30,000 baby salmon released in 1981 were about to reappear. But everything has fallen apart and is at rock bottom again. A recovery is possible but it will take a long time, a minimum of five or ten years.

PAGES FROM A STUDENTS DIARY

3rd November

We went to the bank of the river near the Inter State Bus Terminal on the Ring Road. The water of the river Yamuna was extremely grimy, grey and heavily polluted.There were old flowers, plastic bags, food and other waste material, literally garbage floating in the water. We were shocked to see the dead bodies of a rat and a buffalo floating in the water.

At two places in the river we saw sewage flowing into it from the nullahs. The water was filthy, black, smelly and most unhygienic. There were many people bathing in the river and drinking its waters. When we talked to them they told us that the river Yamuna is old and sacred and can never get polluted. How can people be so foolish?!

While returning we stopped at the Shahdara Bridge. A slum colony existed here and people were washing grains and cereals in the river, before cooking them, to be served in the nearby dhabas.

They were also washing dirty rags they had collected as 'kabadi' from factories, export houses and hospitals. After washing them in the river, they were recycled into lots for further use.... somewhere else?!

Activity

TRY BEING AN EDITOR

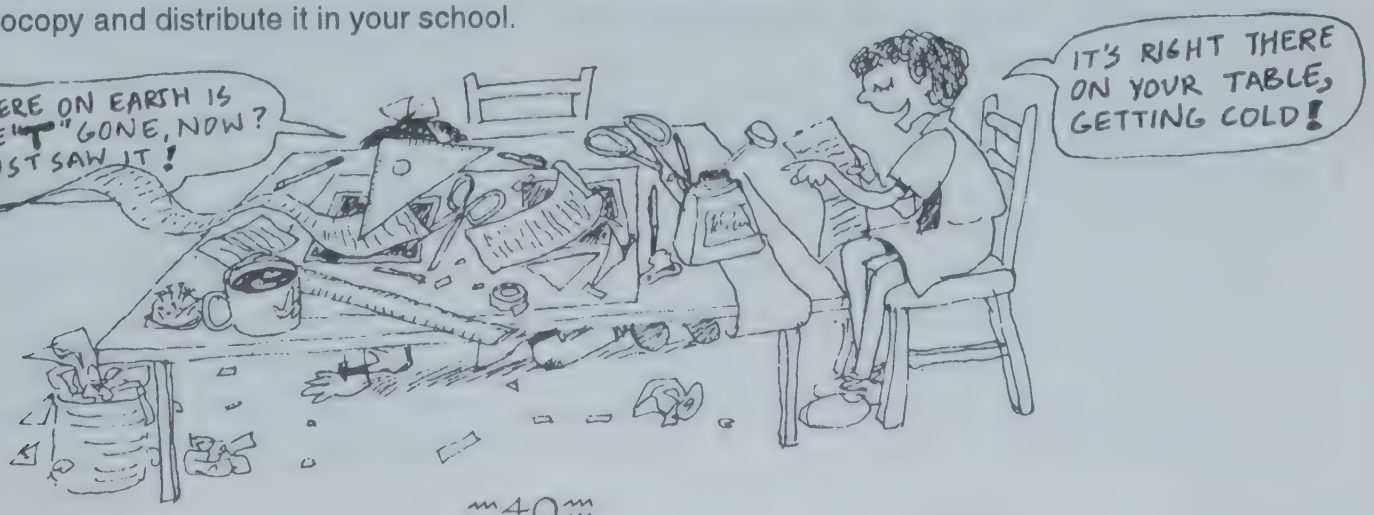
An interesting and fascinating activity, is that of creating the front page of a newspaper. But with a difference. The theme of your entire front page will be THE POLLUTION OF THE RIVER.

Collect material on the pollution of your river through library research, visit your local newspaper office for information, cut out pictures, take photographs, write articles, poems etc.

Interview people and develop case studies with photographs. Create your own masthead, box items like weather, TV and radio programme information, advertisements and cartoons.

All these should be related to only one theme : **POLLUTION**

Write out your material in columns resembling a newspaper and design its layout. You may use a typewriter, a computer or even free hand writing. Paste your material in place according to your lay out. Photocopy and distribute it in your school.



The waters of the river never turn back again
The cut-away twig never sprouts again
The married daughter never returns home

..... Tribal folk-song

Coffee Coloured Waters of the Tungabhadra

Till 14 February 1984, life on the banks of the Tungabhadra, the major river in Karnataka went on as usual. In the Dharwad district which was never dry and backward, abundant water was available around the year from the river. The area has an interesting mix of professions - a large population of fisherfolk, farmers, weavers and spinners and a large nomadic sheep rearing community as well. A popular local saying goes 'You must bathe in the Ganga, and drink from the Tunga.' The river is the lifeline of the 27 villages that dot its banks.

But on February 14, 1984, the river suddenly produced a harvest of dead fish in thousands. In the same year all the communities began to see a sudden drop in their earning capacity, as the environment was fast deteriorating. While the sheep began aborting their young, the groundnut production dropped by 90% and people in the villages on the banks of the Tungabhadra reported skin rashes and itching from all those who spent more than four hours a day in the water; and most dramatically, a sudden surge of abdominal complaints occurred, often necessitating surgery. The District Commissioner suggested evacuation of some of the villages.

The culprit for poisoning the river was not far away : industrial effluents from the factories of Harihar Polyfibres(HPF), and the Gwalior Rayon and Silk Manufactures(GRASIM), the makers of Gwalior Suiting. Those two units discharge about 33,000 cubic metres of effluents into the Tungabhadra daily. During the monsoon these effluents get diluted, but in the summer months the waters of the river turn the colour of dark coffee. Amazingly these two industries operate without permission from the authorities under the Water and Air Act. People call the polluted air around the industries 'Birla Perfume': the polluted water, 'Birla Kalpataru'. People afflicted by pollution agonize 'Today the fish die; tomorrow, we all die'.

A local NGO, the Samaja Parivartana Samudaya took on the job of extensively documenting the effects of the pollution, bringing about an awareness and organising the people, and another NGO the Transnational Centre filed a case in the Karnataka High Court.

For over ten years this battle has continued, and the pollution has continued as well. Despite a lot of community mobilization by the Samaj Parivartana Samudaya, a detailed study by the Department for Science and Technology and action by the Karnataka State Pollution Control Board, the case has been pending a decision in the High Court.

How does such pollution really affect the delicate eco-system of a river? Whenever effluent is dumped into a river, solids sink to the bottom and are attacked by either aerobes (micro-organisms that require oxygen to survive) or anaerobes (micro-organisms that do not require oxygen for their survival). While aerobes are found at higher levels of water, anaerobes are found at lower levels. These organisms consume the rubbish, converting the organic matter into inorganic substances and minerals.

The process of conversion uses up the precious oxygen reserves of water that are produced by algae and other water plants.

Protozoa, another kind of organism that are usually unicellular, destroy the disease causing germs in the waste, and these, too, requires oxygen. If the rate or the quantity of rubbish being dumped in a river is too high, the oxygen in the water may not be enough for the aerobes and protozoa to treat the waste, and these useful organisms may die out. Besides, as the oxygen level in the upper layers of the river water falls, the anaerobes rise towards the surface and begin to attack the waste matter. This makes the water very smelly.

Activity

MAKE YOUR OWN BOARD GAME

Why not try to design and make an original board game, that takes not more than twenty minutes to play? Remember, it must be based on a theme linked to the neighbouring river.

Begin by recording some ideas for at least three different basic possibilities, referring to board games you already have played and are familiar with. For example you might start by combining the basics of Ludo, with a board depicting a river and play pieces being boats. Identify the idea you think will be the most successful, and list the reasons for your choice.

Now, explore the idea in more detail, starting with rough sketches and working towards a full-size prototype to be made of paper. Remember to make a successful game, you need to include the following components:

- throwing dice
- picking up instruction cards
- making decisions on directions of movement of playing pieces
- blocking other players
- scoring points on the way

Test the prototype out by playing it through once, and discussing it with other people. Check whether your game:-

- gets started quickly enough.
- becomes dull or repetitive at any stage.
- comes to a successful conclusion.

Make clear notes of the changes you decide to make as a result of testing your prototype. Now you can begin to develop and refine the description of how to play the game, and the rules that are required.

Work out how you can make the board look as visually interesting as possible by incorporating colourful images around your theme. Use some verbal references to help co-ordinate the playing cards and locations on the boards.

Now you've reached the stage of Final Realization.

Construct and prepare the art work for the final version in thin card as neatly and accurately as possible. Include the playing instructions and rules, place it in an appropriate box and your game is really to be played by a team of unknown players.

DYE YOUR WATER

How does water flow? Try dropping a drop of any coloured dye or ink in a bowl/basin/tub of water. Watch what happens.

By this simple technique of adding dye, you can draw quite a few secrets from the water and solve some of the following:

How does water move?

How does water mix with another liquid?

How do currents run or flow?

How does the water at the top of a kettle heat up?

How long does water which has been stirred, tum round and round? Or how long does water remember in which direction it was stirred?

How long does a crystal take to dissolve in water?

How does a dissolved or a dissolving substance spread

- through moving water?
- through still water?
- through cold water?
- through hot water?
- through heating water?

Water management

Dangerous dams. An unclean water supply. Battles between states on water sharing. Bridge collapses. All these different aspects of water management seem to dominate the headlines of our newspapers daily. From each one of these issues, a host of questions arise. Should big dams be built at all? Are they really 'the temples of modern India,' as Jawaharlal Nehru referred to them forty years ago, or are they an obsolete way of providing irrigation and generating electricity? In the final analysis - do dams have too great an environmental cost?
In this chapter we look at the varied elements that make up the entire area of water management, beginning with dams.

Right from the beginning of history, it was to a large extent the question of an adequate water supply which decided where a nomadic tribe finally settled. But for drinking purposes and keeping things clean - we don't only need water, but more important 'clean' water. Wherever human beings settle they tend to dirty the nearby streams, and after a certain time the supply of water from wells becomes insufficient. Very quickly the need arises to either keep the water source clean enough for drinking, or to bring 'good' water from another distant source.

Over 2000 years ago, it was the Romans who chose the second of these alternatives and brought water into Rome and other great cities by building aqueducts. These were artificial channels in which water flowed down a slight slope from some unpolluted source. Tunnels were bored through mountains to bring the water, and these channels even crossed valleys on a series of arches. Till today in Southern France you can see a three-tiered aqueduct spanning a 255 m. wide valley. These aqueducts brought enough water into Rome to make available 920 lts. of water per person, and there were a million and a half people living in Rome at that time! Can you calculate how much water came in everyday, and every year? Till today, few cities can boast of as efficient a water supply system.

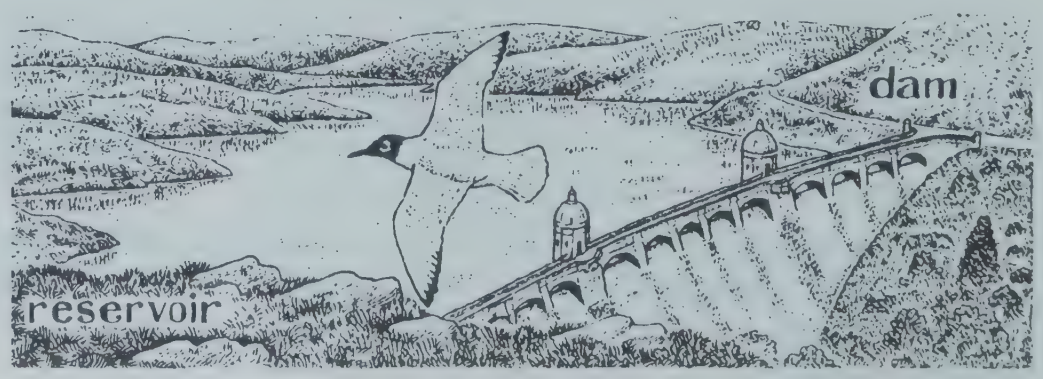
Activity

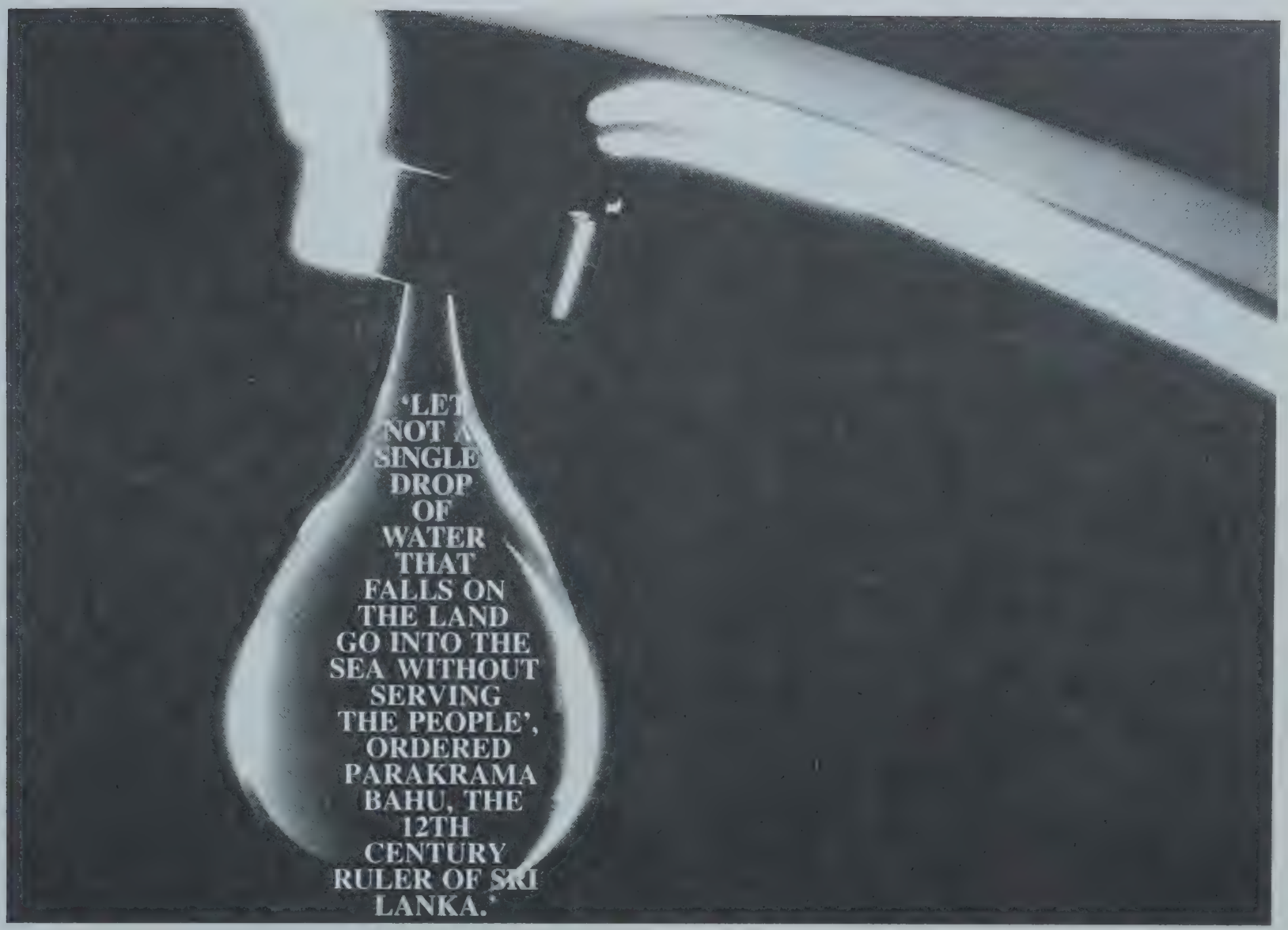
SAID THE MOSQUITO TO THE FISHERMAN

Hold a public hearing on whether to build a dam on a certain river or not. Lobbyists come to the meeting - a farmer, a fisherman, a fish, another (well known) dam, an old banyan tree, a kingfisher, a mosquito and any other who, you think, should be considered. Enact the scene between them.

Reservoirs are used to store water, mostly for drinking and irrigation. Some are large artificial pools; others are dammed lakes or drowned valleys.

Dams are built to contain reservoirs, to control flow or to generate power. Some are long, gradual slopes; others are massive structures built to withstand incredible pressures.




'LET NOT A SINGLE DROP OF WATER THAT FALLS ON THE LAND GO INTO THE SEA WITHOUT SERVING THE PEOPLE', ORDERED PARAKRAMA BAHU, THE 12TH CENTURY RULER OF SRI LANKA.'

A Ballad for Ecology

by kenneth e. boulding

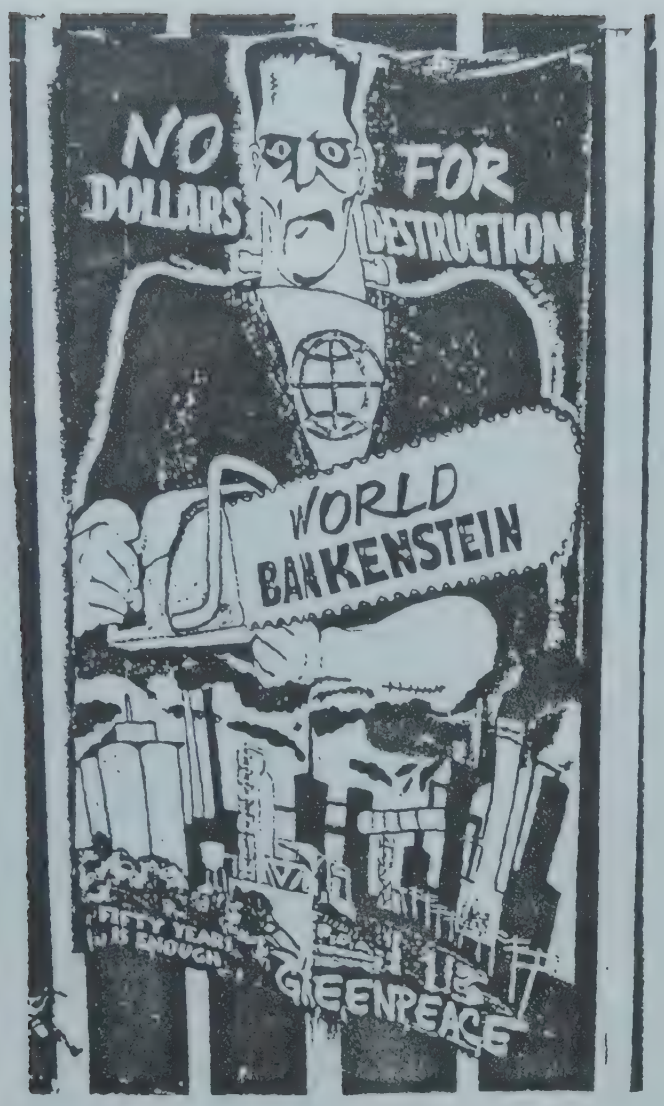
The cost of building dams is always underestimated
There's erosion of the delta that the river has created.
There's fertile soil below the dam that's likely to be looted.
And the tangled mass of forest that has to be uprooted.
There's the breaking up of cultures, with old haunts and habits lost
There's the educational programme that just doesn't come across.
For engineers, however good, are likely to be guilty
Of quietly forgetting that a river can be silty.
While the irrigation people too are frequently forgetting
That water poured upon the land is likely to be wetting.
Then the water in the lake and what the lake releases
Is crawling with infected snails and waterborne diseases.
There's a hideous locust breeding ground when the water level's low.
And a million ecological facts we really do not know.

Activity

THE FORCE OF THE SURGE

Why do you think the wall of a dam is thickest at the bottom? To find out, you will need two identical empty plastic bottles (mineral water bottles will do), a nail and scotch tape. First, cut the tops off both the bottles. Then use the nail to make several holes about 2 cms from the bottom of one the bottles. Fill the bottle with water. Are the jets of water that come out all the same length?

Now take the other bottle. Make a row of holes up one side of the bottle. All the holes should be in a straight line, one below the other and have an equal distance between them. Cover these holes with a strip of scotch tape. Fill the bottle with water, and then gradually pull away the strip from the top of the bottle, revealing one hole at a time. Which jet of water is the longest and which is the shortest? Why? Does this explain why the wall of a dam is thickest at the bottom?



The most dramatic of the hidden costs of building a dam is that of resettlement which, as a rule of thumb, is around U.S. $10,000 a family, according to the World Bank, the largest single financing agency for large dams. The photograph on the left shows a banner put up by the environmental NGO : Greenpeace to protest the policies of the World Bank.

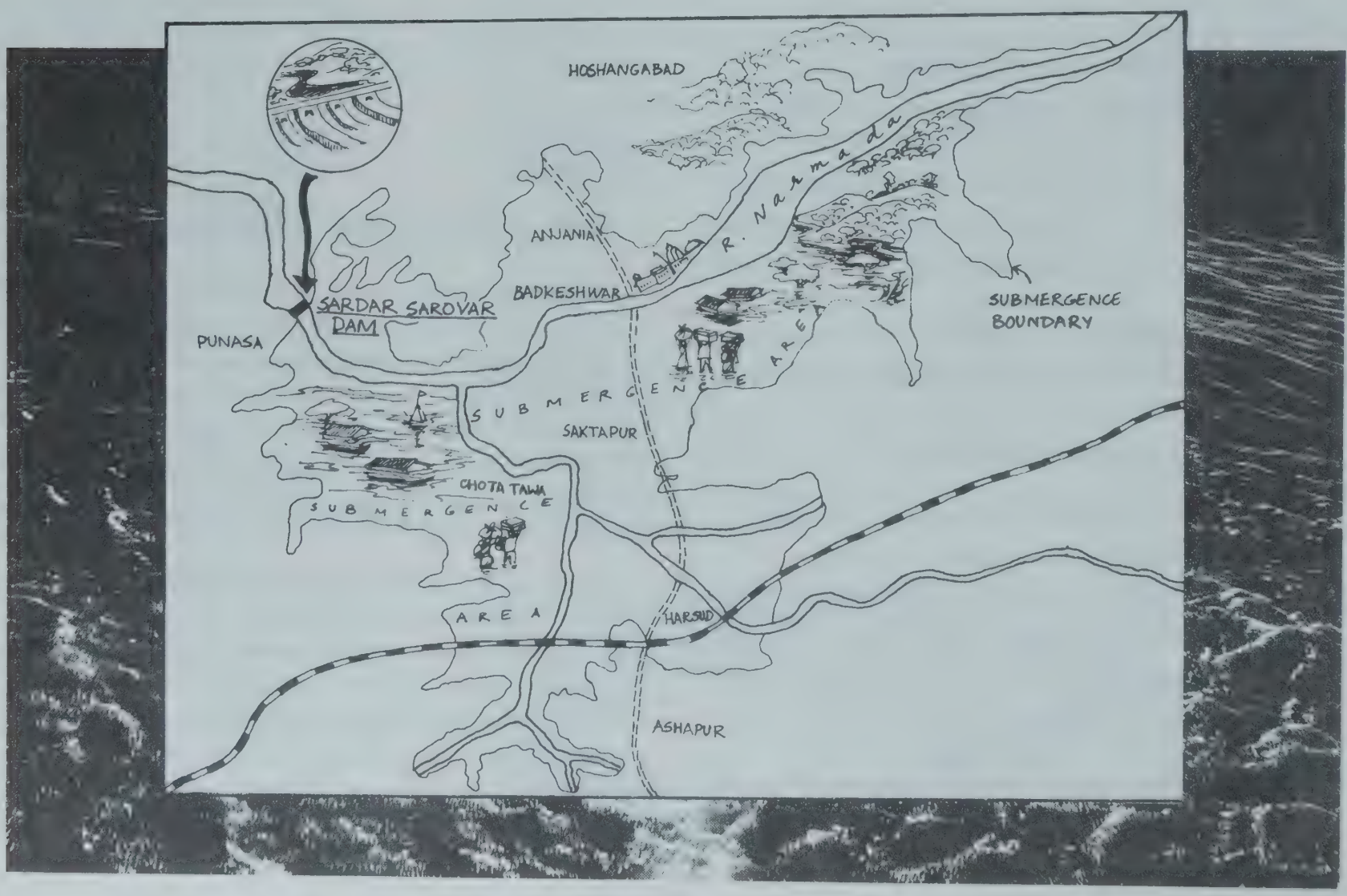
Activity

PROS AND CONS OF THE NARMADA PROJECT

Go to your library and look for articles, news items, information about the Narmada Valley Development Project. Collect all the information in the class and tabulate it under the following heads.

Factors in favour of the Dam Project	Factors against the Dam Project
_____	_____
_____	_____
_____	_____

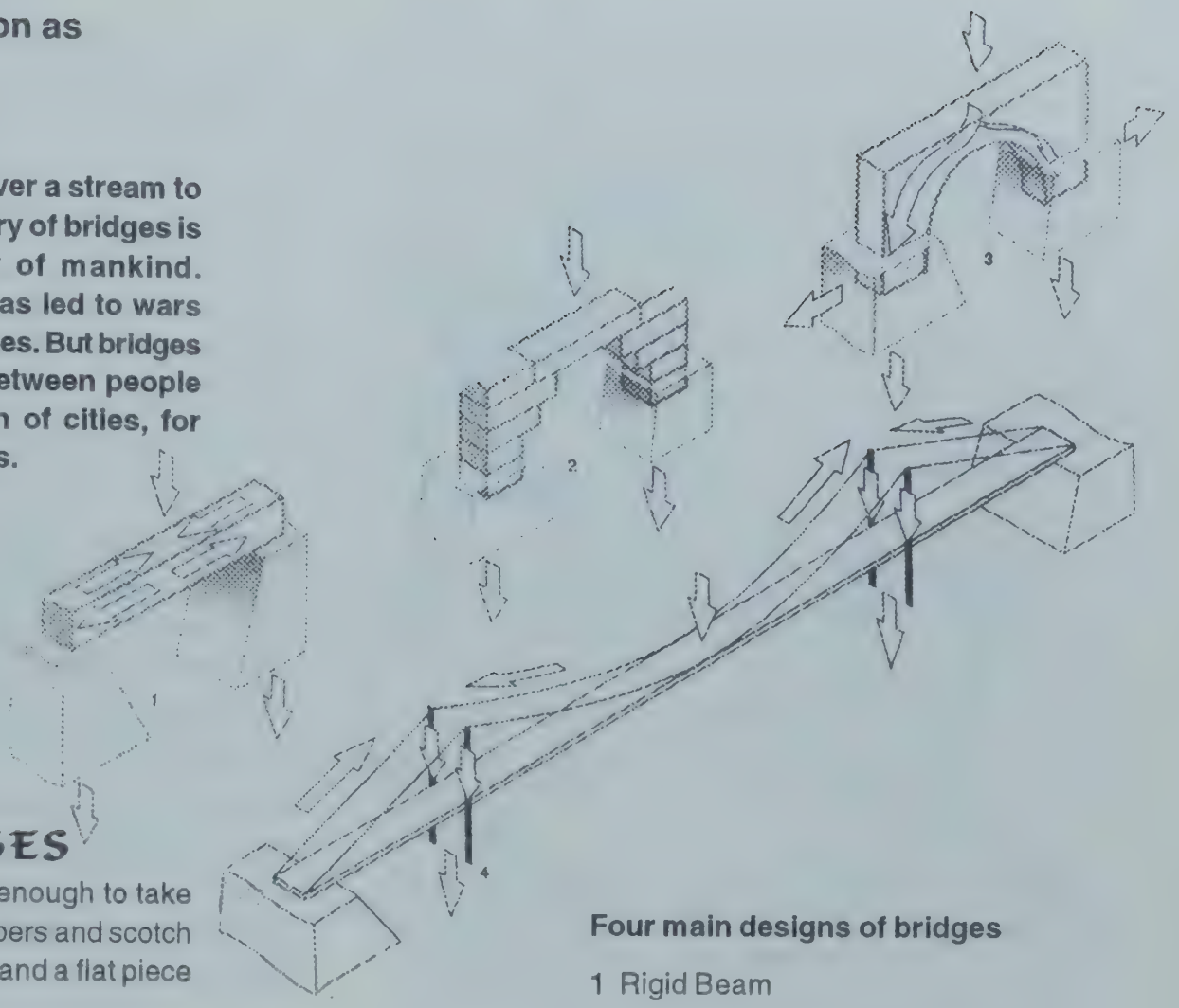
Share this chart with the other groups and make a presentation of the same at the school assembly, using the medium of declamation, debates or a mock court trial based on the information collected.



'Adventure begins as soon as you cross the bridge'

Georges Brassens

From the first stones placed over a stream to logs spanning a river, the history of bridges is synonymous with the story of mankind. Crossing to the other shore has led to wars and the conquest of new territories. But bridges have also strenghtened ties between people and contributed to the growth of cities, for which aqueducts were life lines.



Four main designs of bridges

1 Rigid Beam

2 Cantilever

3 Arch

4 Suspension

All bridges are based on two main principles : tension and comprehension

Activity

BUILDING BRIDGES

Can you build a bridge strong enough to take your weight, using only newspapers and scotch tape? You will also need a ruler and a flat piece of wood.

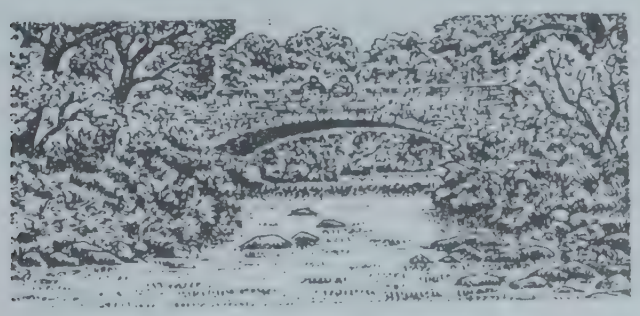
Before beginning this experiment, weigh yourself on a weighing machine so that you know exactly what your weight is.

First, move two tables in your classroom so that there is a gap 50 cms. wide between them. Now using only the newspapers and the scotch tape you have to build a bridge strong enough to carry your complete body weight!

What kind of bridge do you think will be best- a beam bridge, a suspension bridge, an arch bridge or a cantilever bridge?

If you don't know what these terms mean, look them up in an encyclopedia.

Once your bridge of newspapers is ready, place the piece of wood on it so that you can stand on the bridge. But before you attempt to do so, place some weight on it that is equal to your own weight !

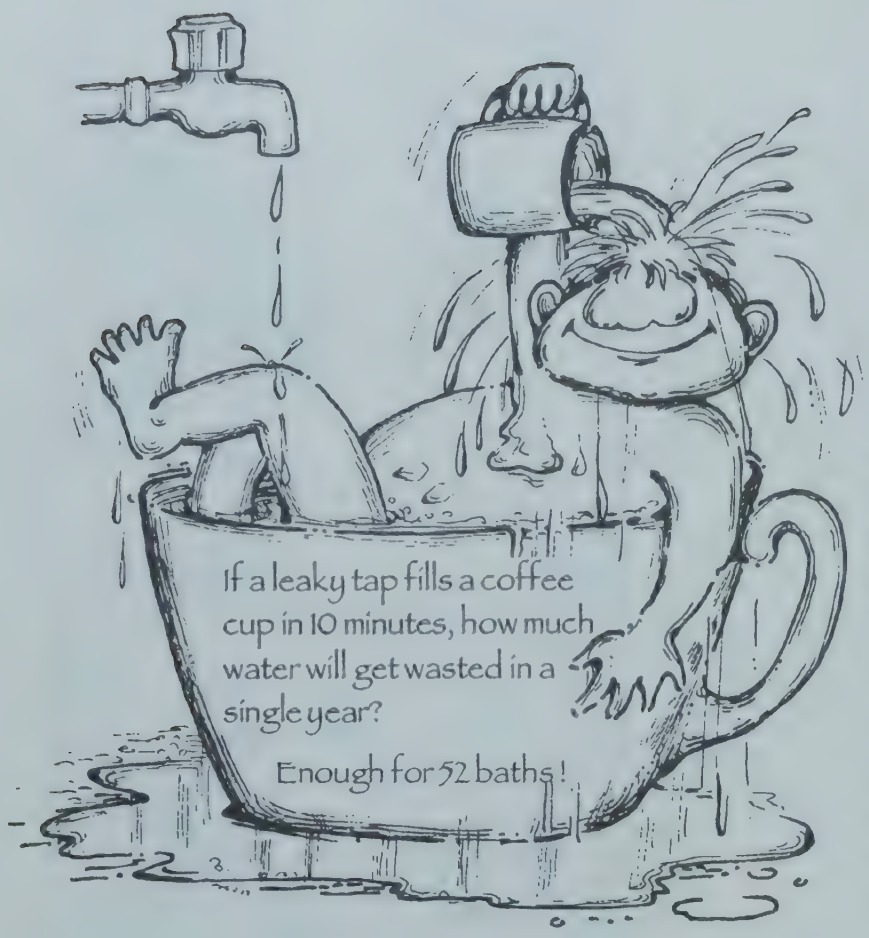


Bridges form another important aspect of Water Management.

Over a hundred years ago, a traveller describes crossing the many rivers near the Rohtang Pass :

The descent, at first very gradual, soon becomes steep, and in some places almost precipitous. It leads down to the left bank of the Chandra river, which foams along the bottom with great rapidity. We crossed by a suspension bridge, formed of ropes of birch twigs, about one hundred feet in length; this was the third different description of bridge which had occurred in the last few marches. We had walked across the wooden (sango or shingzam) bridge, we had been slung over the rope-bridge (or jhula), we had sat astride on inflated skins (deris), and so been ferried across; but now had come the most ticklish operation of all.

Pendant between two ropes of birch twigs, which stretched across the stream from rude piers erected on either bank, hung, cradlelike, a continuous hurdle of the same frail material, attached to the ropes above by a sort of open basket-work; this was the footway, and the ropes above served as balustrades on either side. This footway was further supported by two or three smaller birchen ropes laid side by side beneath it and stretching across the stream in the same manner as the two upper ropes. This rude suspension bridge is called 'chuqzam' by the natives, and is common in many parts of Ladak.



Another crucial element of water management is that of the water works of your town. On the one hand, how do we make water clean enough for drinking, and supply it to the entire town; and on the other, how do we deal with the enormous volume of 'dirty water' that a city produces?

On this page you will find four different items on how such issues are being tackled today. On the double spread on Traditional Tanks (pg 65) that follows, you will also gain an insight into how these issues were addressed in the past.

Moringa Magic

Do you ever really just turn on your kitchen tap and drink water straight from it? No way!

Having a clean, safe supply of drinking water is still a pipe dream in most of our towns and cities. Most of us either install a water filter or boil the water we drink, to stay away from those pernicious water-borne diseases cholera, jaundice, diarrhoea.... But how did people manage in the past? What were the traditional ways of purifying water before drinking it?

One way, mentioned as early as in the Sushruta Samhita is using the seeds of the Nirmali tree. These seeds are rubbed on the inner walls of a ghada(or matka) before water is poured into it, so that once the water is poured in, it will purify it. In the same text, the seeds of the drumstick tree are also mentioned as water purifiers. Research shows that these seeds, known as moringa seeds, can replace the costly alum used in most water treatment plants today. These seeds are so effective, that just 30 moringa seeds can purify as much as 40 litres of water. At present the Universities of Malawi (Africa) and of Leicester (UK) are carrying out a conjoint research study on how moringa seeds can be used to meet contemporary needs.

Activity

TRADITIONAL WAYS

Talk to your grandmother or any other older relative, as to how they purified and stored drinking water when they were young. For instance in certain parts of our country, copper bottomed vessels were used for storing water. Why? Maybe your science teacher can help you with an answer. In other parts of India such as Kerala, wells are regularly cleaned by throwing in burnt coconut husks. Why? Tulsi leaves and amla wood have also traditionally been used for water purification.

Investigate these and other related traditional practices of your own home. Can you revive any of these traditional practices today and keep them 'alive'?

- Class I and Class II cities in India generate 2000 crore litres of sewage wastewater every day, but treat only a tenth!
- The total sewage generation from urban centres has grown six times in the last 40 years.
- The water requirement of major water-consuming industries such as agro-based refineries, petrochemicals, fertilisers and chemical has grown 40 times, but these industries are not treating the huge wastewater generated as yet.

from a study by
Tata Energy Research Institute.

Activity

WATERWORKS VISIT

Visit the water works of your town.

Each one of you can carry a worksheet to collect information and understand the system. This worksheet should be prepared by the group after a brainstorming session, before making the visit.

- Follow the process of water treatment and draw the entire process from entry to exit- label the diagram.
- How much water is processed through the plant everyday?
- Does it clean the sediments alone or bacteria and germs too?
- What are the chemicals and purifiers added to make the water "drinkable"?
- How many people are needed to make the plant work?
- Any special treatment at the time of epidemics?
- Get a water distribution map for the city.

THE BENEFIT OF SEWAGE

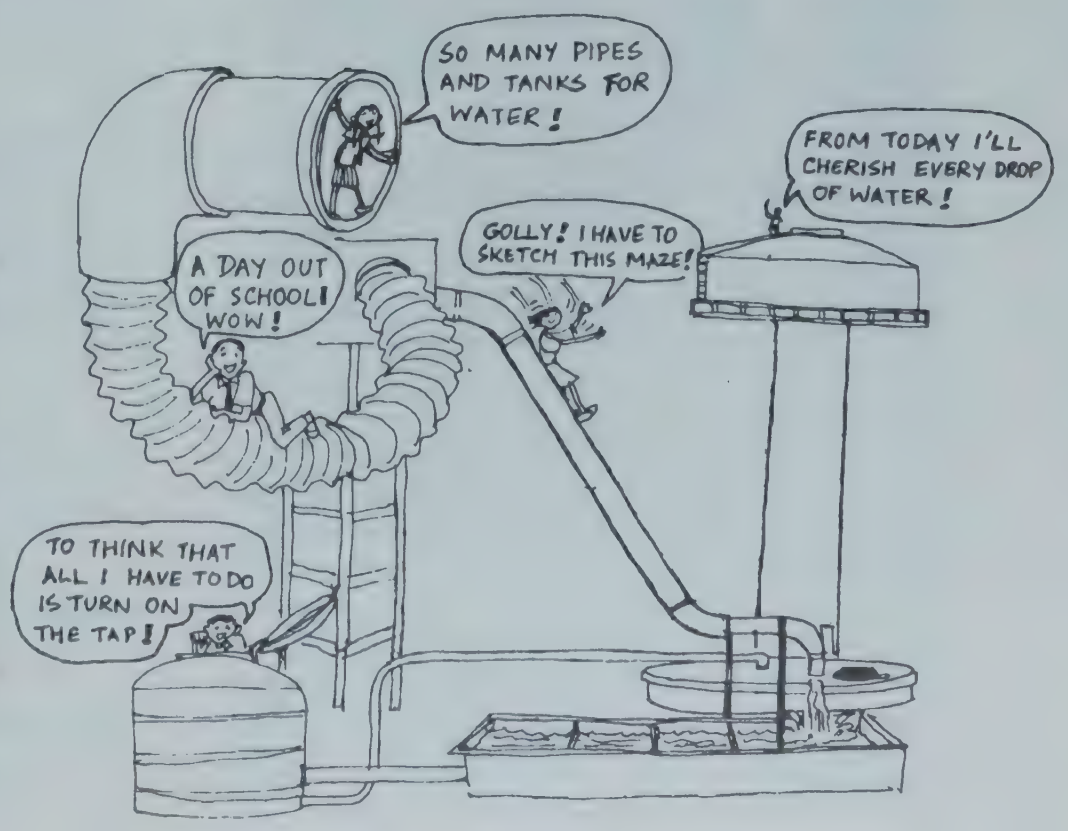
Where does the sewage from our houses, particularly from our bathrooms go? Do you know that tonnes of untreated sewage enters the river everyday? But instead of looking at this issue as one of cleaning pollutants, shouldn't we look at sewage as being a resource in itself?

Impossible? But this is what several farmers on the outskirts of Calcutta are doing today. It is here in Bandipur that 14 million litres of sewage from Titengarh town are treated through a series of village ponds, before being used for irrigation purposes.

The sewage is treated through a series of ponds and is also used for cultivating fish.The raw sewage is introduced into the first pond known as the septic zone. Here, heavier particles in the water settle down, and through the action of the bacteria, this organic waste becomes the food of the algae. From there it flows into the next zone, the eutrophic zone where fish cultivation starts .

The sewage actually helps in fish production in two ways, indirectly and directly. Indirectly it fosters the growth of algae and phytoplanktons which act as a source of food for fish. Directly, fish like carps, feed on sewage. Since the ponds are shallow and allow the entry of sunlight, much of the bacteria present in the sewage are killed and the process of photosynthesis takes place in algae. That is why the eutrophic zone contains a higher level of dissolved oxygen than the septic and outlet zones.

After 10 or 15 days in the second tank, the water goes into the outlet zone and is used for irrigating crops . Due to the increased irrigation in the area, the farmers are able to harvest a second crop of rice every year.


SO MANY PIPES AND TANKS FOR WATER!
FROM TODAY I'LL CHERISH EVERY DROP OF WATER!
GOLLY! I HAVE TO SKETCH THIS MAZE!
A DAY OUT OF SCHOOL! WOW!
TO THINK THAT ALL I HAVE TO DO IS TURN ON THE TAP!

A very recurrent international problem today is the release of oil and other pollutants into the waters of a river. A leaking tanker, the explosion of an off shore oil rig, oil as a part of the effluent from a factory - all of these can have lethal consequences for life in the water. See the related stories in the following pages.

By carrying out the following scientific experiment and answering the questions that follow, you will begin to comprehend how difficult and complex it is to clean up an oil spill, and the havoc it plays with the delicate eco-system of a river.

Activity

OILY WATERS

You will need:

an aluminum thali
oil
motor oil, used or new
cotton balls
a spoon
an eye dropper
a piece of nylon net
a pair of nylon hose (stockings)
a piece of styrofoam
a piece of cardboard
a length of string
straw
detergent

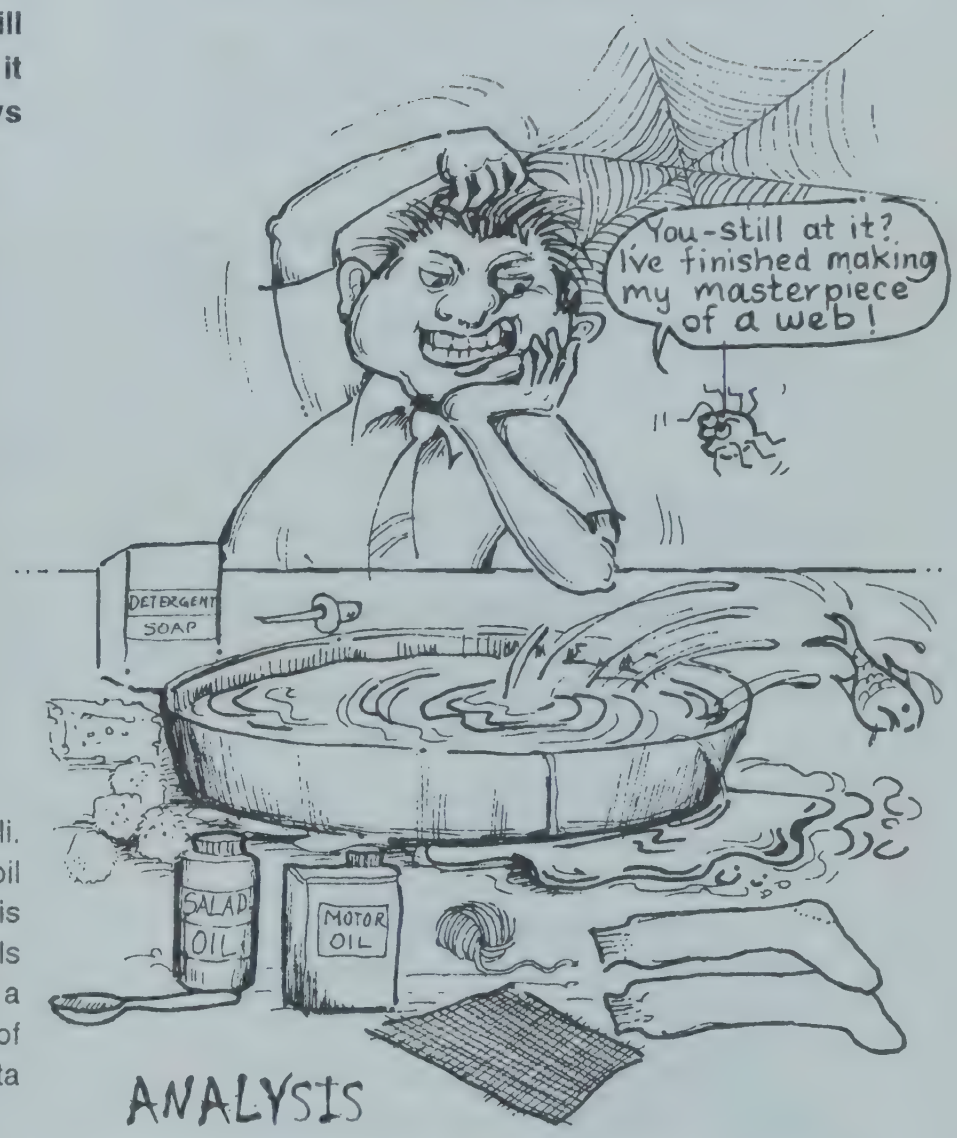
1. Place about one inch of water in the aluminum thali. Use an eye dropper to place 15-20 drops of cooking oil on the surface of this water. The problem you face is how to clean up the oil. Select any of the materials available and use them to clean up the oil slick. Use a watch with a second hand to determine the amount of time it takes you to clean up the spill. Make a Data Chart to record your results.

2. Repeat the simulation by adding new cooking oil. Try at least three different techniques and materials and record the results.

3. Upto this point you have been using a 'light oil'. Now perform the same procedure using a heavier oil such as motor oil. Record your results in the Data Chart.

4. You have been very lucky so far ! The weather for your oil recovery operations has been fair and calm. But many oil spills occur when the weather is stormy. To simulate rough weather, carefully make waves in your model ocean by gently blowing over the surface or by moving a card through the water. Repeat two of the techniques with heavy oil and rough water. Record your data in the Data Chart.

5. Select the method you feel works best and modify it as follows. After you have added the 15-20 drops of heavy oil, add 5-10 drops of detergent. Then proceed to remove the oil/soap mixture with the technique you have selected. Record your results in the Data Chart.



ANALYSIS

1. a) With which method were you able to clean up the oil spill most rapidly?

   b) Which method was the most effective with light (i.e. cooking) oil?

   c) Was the same method most effective with heavy oil? If not, which method was the most effective with the heavy oil (i.e. motor oil)?

2. a) The first activities following an oil spill involve attempts to 'contain' the spill. Containment keeps the spills from spreading. Which of the materials provided would help to 'contain' an oil spill?

   b) Oceans spills are often contained by placing 'booms'. A 'boom' is a barrier or fence of some type. Floating logs, foam and rubber tubes have been tried. Under what weather conditions would booms work best?

What a wonderful way to use old umbrellas!

3. Most of the oil removal techniques which use the materials provided remove the oil by 'adsorption'. The oil is picked up (adsorbed) on other substances like straw and sawdust.The oil soaked materials are then removed from the water.

   a) Which of the techniques that you used, removed oil by 'adsorption'?

   b) Some people say that these techniques simply move the oil spill from the water to the land. What do you suppose they mean by this?

4. a) What effect did the detergent have on your oil spill?

   b) Did the detergent make your cleanup technique more effective or less effective? Please explain.

   c) Detergents are useful in cleaning, because they kill bacteria. Does the fact that the detergent kill living things present any problems when detergents are used to cleanup oil spills? Please explain. What are its implications for the ecosystem of a river?

5. Fire is another technique often used to remove oil spills. The oil spill is ignited and allowed to burn.

   a) Where does the oil from the water go when it is burned?

   b) What kinds of problems might this cause to the fish and other organisms that live in the water?

Americans withdraw about 1515 billion litres of water each day for residential, industrial and agricultural purposes. This figure translates into 37,855 litres for each person each day in USA!

Compare this with the daily average of 220 litres each resident of Delhi gets. The figure is 190 in Calcutta, 155 in Bombay and 70 in Madras. In our villages, no one gets more than ten litres of water daily, that's the average on the good days (and ten litres won't fill one standard sized bucket). Often, it falls to six litres and on some days to nil.

from Everyone Loves A Good Drought
by P. Sainath

PAGES FROM A STUDENTS DIARY

17 August

After our first visit to the Yamuna and the boatride, I had got into the habit of making a note of the river water level, indicated on the bridge, every morning, while crossing in my school bus. As the school opened after the summer vacations this practice proved to be very exciting. As the rains continued day after day, the river water was steadily rising. Yesterday it had crossed the danger mark and warnings were being called out on loudspeakers in the area around the river bank.

On my way back from school, I saw a lot of movement and action, on the eastern side, which is the lower bank of the river. I, along with two of my friends, crossed the river and got off the bus. And what do you think we saw?

People who were living in the area in small temporary houses, were collecting their meagre belongings, putting them on to inverted 'charpoys' and moving them to the safety of the nearby roof tops. It continued to rain and the river was in full spate.

By this morning the 'jhuggies' were totally submerged. The river bed had become one wide torrent of water gushing forward. Clusters of people were huddled together with their belongings, seeking refuge and waiting for the water to recede. I was happy that they had been able to reach safety, before it was too late! However with their homes destroyed, what will they do tomorrow?

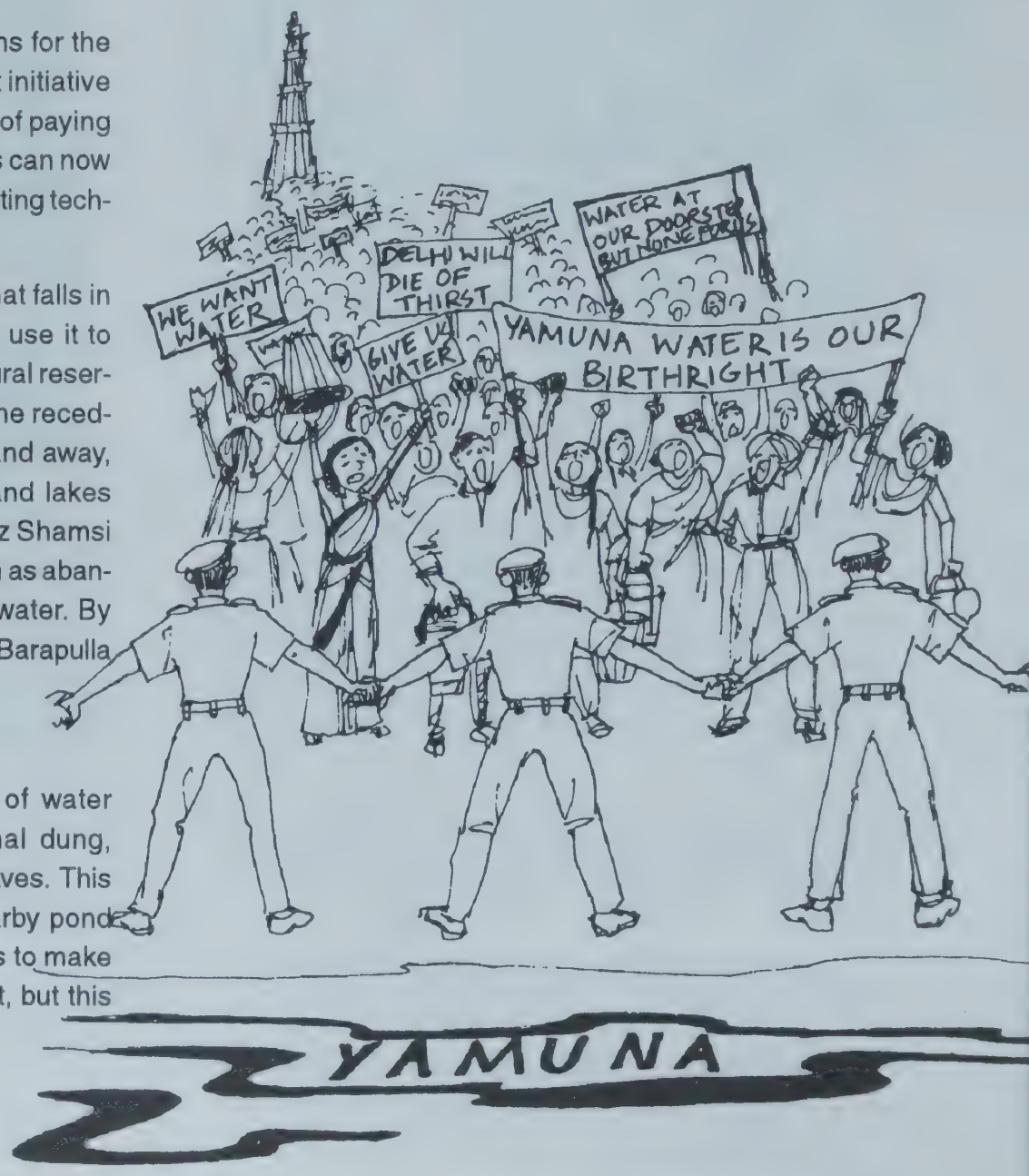
HOPE FOR DELHI

Delhi's water supply has been in the doldrums for the past several years, but hope lies in the recent initiative by INTACH, Pani Morcha and others. Instead of paying Rs.10/- for a pitcher of water, Delhi's residents can now look forward to a revival of earlier water harvesting techniques.

By harvesting (collecting) all the rain water that falls in the Capital, even on our rooftops, we could use it to recharge the aquifers and to fill four large natural reservoirs and two small ones. Further collecting the receding floodwater - instead of letting it flow on and away, would also help. In addition, all the tanks and lakes built during medieval times (Hauz Khas, Hauz Shamsi etc.) could be recommissioned, and areas such as abandoned quarries could be used to store rainwater. By planting trees, the flow of streams such as the Barapulla and the Ridge Stream could be improved.

• • •

A very inexpensive technique for storage of water involves lining ponds with a layer of animal dung, covered with freshly cut grass and banana leaves. This is topped with a layer of wet soil from a nearby pond which is allowed to dry for two to three weeks to make the pond leak proof. You will never believe it, but this technique originated in Russia!


WE WANT WATER
DELHI WILL DIE OF THIRST
GIVE US WATER
WATER AT OUR DOORSTEP BUT NONE FOR US
YAMUNA WATER IS OUR BIRTHRIGHT
YAMUNA

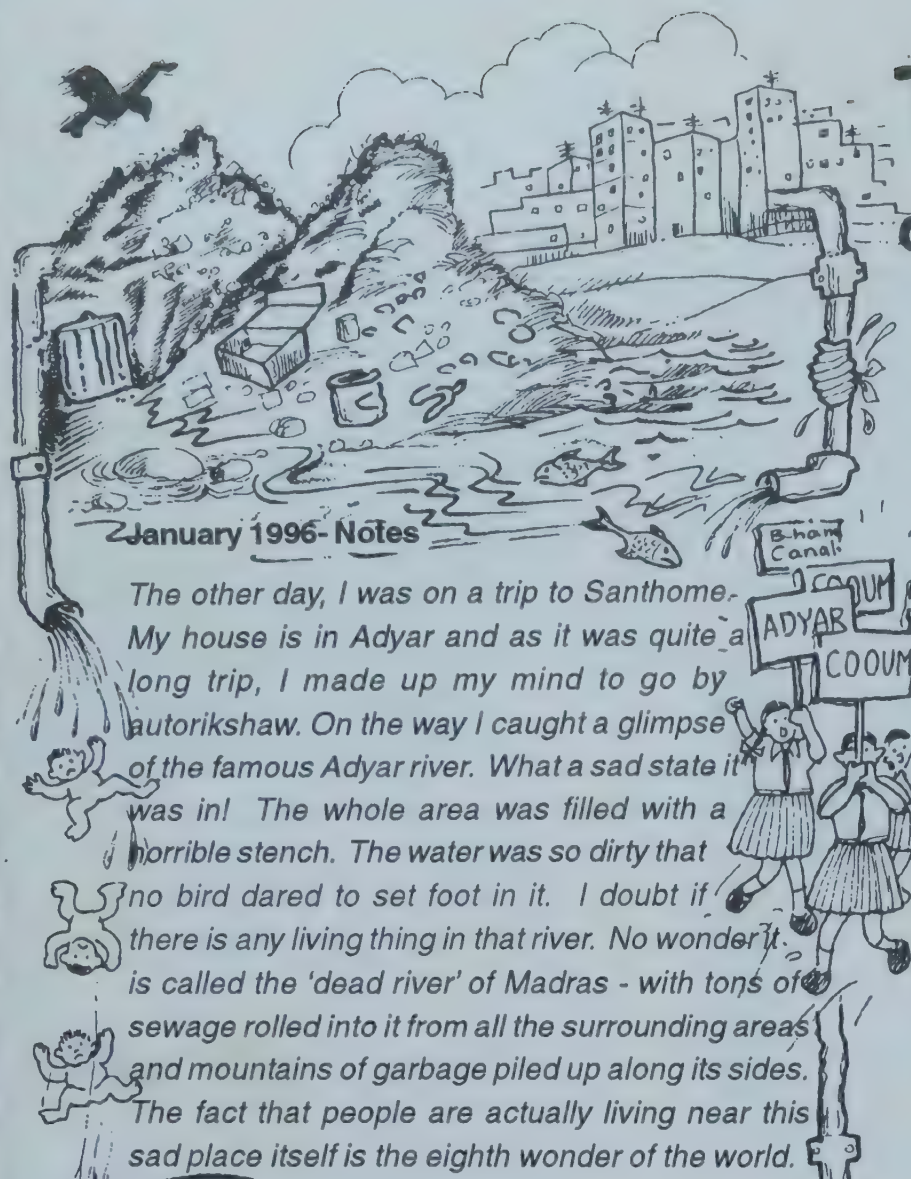
Activity

Complete The Dream

You are sitting in a cinema hall with your family watching a film. After the film is over, when you come out, you find the whole area flooded. You can only see the rooftops of the cars... Go on to describe what you see and do after this.

WE KNEW THE FLOODS WERE NEAR, BUT I HADN'T REALISED WE WERE SO CLOSE TO IT!
FLOODS PREDICTION DEP. METEOROLOGICAL OFFICE
HELP!
FLOODS HELP!

The Waterways of Chennai



January 1996- Notes

The other day, I was on a trip to Santhome. My house is in Adyar and as it was quite a long trip, I made up my mind to go by autorikshaw. On the way I caught a glimpse of the famous Adyar river. What a sad state it was in! The whole area was filled with a horrible stench. The water was so dirty that no bird dared to set foot in it. I doubt if there is any living thing in that river. No wonder it is called the 'dead river' of Madras - with tons of sewage rolled into it from all the surrounding areas and mountains of garbage piled up along its sides. The fact that people are actually living near this sad place itself is the eighth wonder of the world.

Activity

A RIVER OF NO RETURN

On the next page you see illustrations of the survey sheets conducted by the students of Chennai. Prepare a similar sheet of observations of your own riverfront in your town. Conduct the survey in groups. You can highlight your survey sheet with photographs. Give a paragraph at the end analysing your findings.

• • •

The pollution of its four major waterways - the Cooum, the Adyar, the Buckingham Canal and the Otteri Nullah "has damaged the estuarine ecosystems of Chennai, endangered public health, and has made the waterways a liability rather than an asset of the city," says leading environmentalist Appasamy. Discharge of sewage, industrial effluent, sullage and urban wastes along with deterioration in water treatment is the sad story of Chennai's waterways.

The Adyar river originates 40 kms from Chennai and flows for 13 1/2 km through the city before it reaches the Bay of Bengal. Conservationists have succeeded in declaring the Adyar Estuary a natural sanctuary. This area offers a variety of ecosystems; river, marsh, woods, backwaters, islets, sea and open ground. It is a paradise for bird watchers with over 150 species, including flamingoes.

The surplus water from 75 tanks (that are situated in 138 sqare metres of water catchment area) form the Cooum river. Its origin is west of Chennai city near Sattarai village. The total length of the river is 65 km.

Earlier Adyar and Cooum were both rivers flowing through the city. They received surplus water from lakes and tanks (see opposite page). 150 and 450 water bodies discharged their waters into the Cooum and Adyar respectively. This added to the continuous and clean flow of water in the two rivers. Today they are stinking drains with stagnant pools of water and abnormal levels of harmful chemicals and a high incidence of BOD. This is because of excessive withdrawal of fresh water from the tanks and reservoirs for irrigation.

Chennai city and the Cooum river have been linked with the development of a successful business and trading centre from the very beginning.

Business and industry have always needed migrant labour population. But the businessman does not care where and how the labour live. Shanty towns have sprung up along the Cooum for many years. By 1994 more than 25,000 families lived along the 16 km. stretch of the Cooum in the city. Any programme to cleanse the river therefore must include the resettlement of these people.

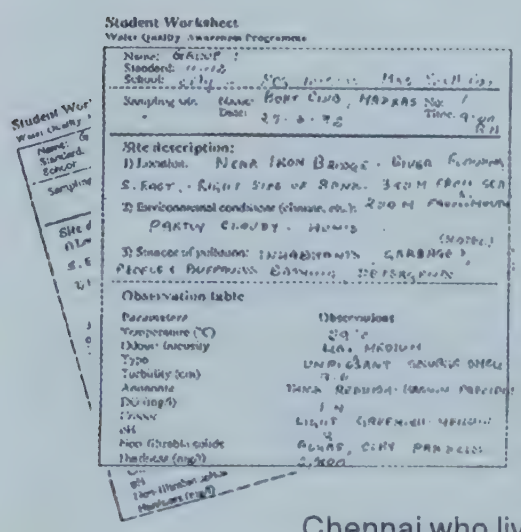
Two hundred years ago the British Administration dug the 420 km. Buckingham Canal. This waterway, bringing in direct sea water, connected Nellore (in Andhra Pradesh) to Chennai. It was used for navigation, saline agriculture, promoting sea food and the people were encouraged to de-salinate the water for their needs.

Fifty years ago the stretch of land along the Buckingham Canal was a green belt. A special saline habitat and eco-system flourished within city limits. Plants, bushes and trees were in abundance along with partridges, quails, pigeons, rabbits and marine life.

As there was a continuous flow of clean sea water, people used the canal for bathing and swimming as well as for washing their cattle. Transportation by simple boats and steam boats was efficient, helping many people to be mobile from the rural hinterland to the main city. In the first decade of this century more than 1500 country boats used to ply on the canal. Today this is all a thing of the past.

ACTION SURVEY

The remedy for the problem outlined on the facing page is always through positive action. WAMP - Citizens Waterways Monitoring Programme - is an organisation of committed individuals and voluntary societies. Its mission is developing clean waterways for Chennai through lobbying and legal action. Environmental education with the young citizens in schools and colleges, public awareness campaigns, media intervention and the preparation of an action plan are part of their strategy.


Student Worksheet
Water Quality Awareness Programme

Name: GROUP 1
Standard:
School:

Sampling stn. Name: PORT CWD, MADRAS No: 1
Date: 27-6-95 Time: 9.00 AM

Site description:
1) Location: NEAR IRON BRIDGE - RIVER
2. EAST - RIGHT SIDE OF BANK - FROM SEA
3) Environmental condition (climate, etc.): ZOOM
PARTLY CLOUDY - HUMID
4) Sources of pollution: HOUSEHOLDS GARBAGE (HOTEL)
PEOPLE DEFECATE BATHING WASHING

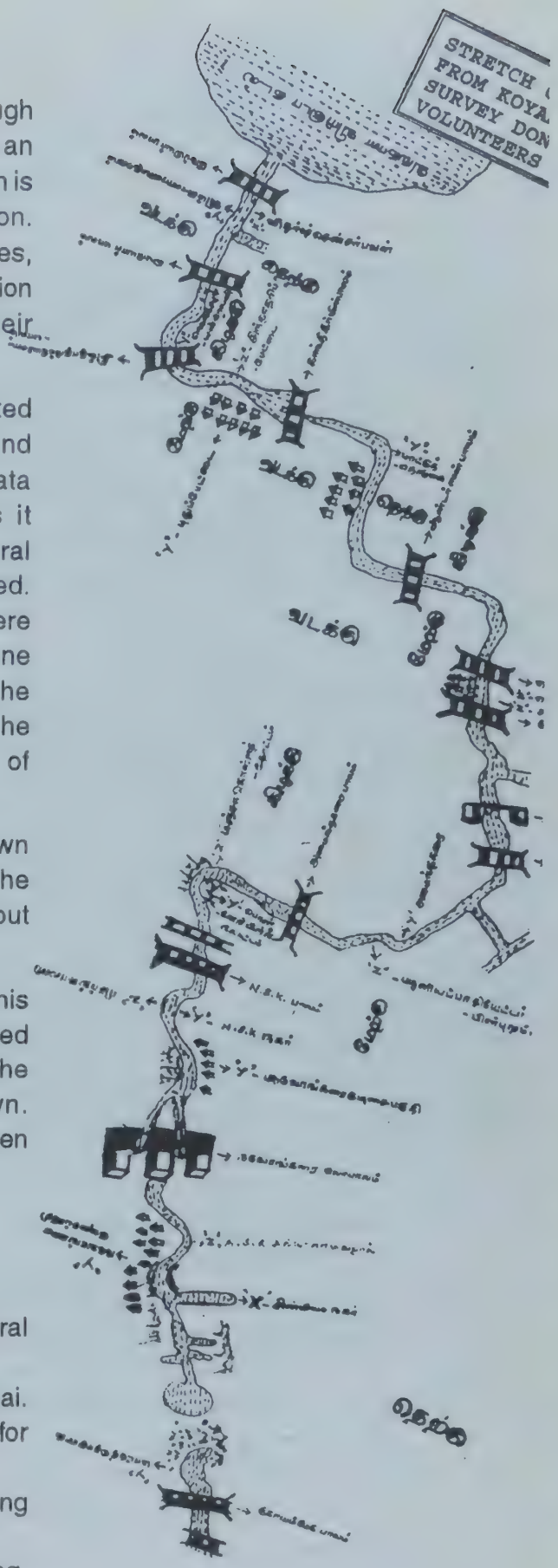
Observation table

Parameters	Observations
Temperature (°C)	29°C
Odour intensity	MOD. MEDIUM
Type	UNPLEASANT SEWAGE SMELL
Turbidity (cm)	0.6
Ammonia	TOXIC REQUIRES CHEMICAL PROCESS
DO (mg/l)	1 N
Colour	LIGHT GREENISH YELLOW
pH	8
Non Carbonic solids	ROCKS, DIRT PARTICLES
Hardness (mg/l)	2,500

Youth volunteers of WAMP conducted a detailed survey of the Adyar and Cooum rivers in 1994-1995. The data collected was very valuable as it covered many parameters. Several new points of pollution were detected. Sewage and industrial outfalls were marked on maps of the rivers. One survey highlighted the gravity of the social problem and the plight of the deprived sections of the population of Chennai who lived on the banks of these two rivers.

To carry out this survey, the volunteers walked long distances down the river bank. This also made an impact on the people. The enormity of the environmental degradation activated many persons to do something about the problem in their own neighbourboods.

The slum dwellers along the waterways are today in the forefront of this awareness programme. They have given valuable inputs and conducted their own surveys and have identified outfalls of sewage and sullage into the rivers from institutions and residences that were earlier unknown. Comprehensive reports and recommendations drawn up by WAMP has been sent to the government.



Highlights:

- ▲ The Corporation dumps its garbage into the Cooum.
- ▲ Slaughter houses dump feathers of hens into the Cooum.
- ▲ Flourishing mangroves along the coast that once provided a rich natural bio-sphere, have been axed.
- ▲ 1989 recorded an overall break down of the sewage system in Chennai.
- ▲ Till 1989 raw sewage was being discharged daily into the Adyar river, for many years.
- ▲ From 1992 - 1994 school children in the city ran a programme of monitoring the water quality of the city's waterways.
- ▲ A senior citizen remembers using the waters of the Cooum for drinking, washing and bathing, 50 years ago.

Making a living

Other than supporting the lives of those who live at it's very edge, rivers have always been a major source of earning a living for millions of people around the world. As you read through this chapter and try out the various activities suggested, you will see how rivers form an integral part of every economy.

Read this amazing paragraph by the famous naturalist Eardley-Wilmot to understand how fishing is carried out in the tidal mangrove creeks of Bengal and Bangladesh.

"The creeks are full of fish, and of fishermen who use nets with skill and success. They have a curious custom of training otters to their services; these animals are secured by a girth to a boom projecting over the gunwale, so that they rest on the surface of the water and can be released as soon as occasion arises. The pack then, after the manner of otters, extend in line across the creek, and drive the frightened fish headlong into the nets, when the otters are again tethered and rewarded with some savoury morsel. In open dugouts may be seen rows of lugubrious cormorants sitting awaiting the order of the paddler, and this is conveyed with emphasis as each bird is pushed into the water, to return after a time with a fish in his beak. A ring on the neck prevents the bird from swallowing his prey, so that he receives for his labour only a fixed wage, and, however skillful he may be, he must go hungry till the fishing is over. There is a great fish-market at Khulna, the chief town of the district, and baskets of fish of assorted sizes, of huge prawns, and of crabs, are daily despatched in the fish-mail to Calcutta."

Hot and sizzling topshey fish,
red-hot puris, too
Meat curry, and cauliflower,
potatoes fried for you
On this winter day, if you
wish to have your fill,
run to my house, I beg of you,
instead of standing still.

Hem Banerjee

RISKS OF THE FISHERMEN

Arampur, Sundarbans. The men are away for a week on their sampan snake like boats, travelling as much as eight hours down the river, fishing for jumbo shrimp, sole and bhetki. They return home for a couple of days every week, and then go fishing again. They carry with them a huge matka of fresh drinking water as the rivers here are salty. They also carry enough rice for ten days, and the boat serves as their bed. By fishing ten months a year, they earn only Rs. 300/- per month.

One of their biggest occupational hazards are man-eating tigers. This village itself has 60 tiger widows. To keep the tigers away, the men have taken to fishing with masks of human faces tied to the back of their heads, as a tiger only attacks man from behind. The only other occupation here is collecting honey from the forests in the months of April and May.

Home is
Rice and saltfish
And green mango pickles

— Cecil Rajendra

A fishing family in contemporary China. Notice the prawns drying on the roof, as well as the fish drying on the clothes line!

Activity

SEASONAL REASON

Does the amount of fish a fisherman catches daily, increase or decrease at different times of the year or is it the same? If there are periods when he cannot fish or catches less fish, how does he earn a living and feed himself ?

Interview your local fisherman to find out.

- Write out a schedule of activities for a single day based on your interview.
- You could also draw up an annual calendar of the activities of the fisherman to see if there are lean seasons and peak seasons.
- Compare what the fisherman gets for a single fish and what you pay in the market. Try and trace who gets the difference in the process. A visit to your local fish market will help you to find out these details.

"The lake looks beautiful
Because of the frolicking fishes
If they are netted away
The lake will look vacant, forlorn."

Song of the tribal group the Mundas, who live in Orissa

When school children in Goa carried out his activity, they not only visited the local fish market and identified numerous fresh water and marine fishes, but they also went further to see the source of the fresh water fish - the Kushvathi river in Sangueri. The students tested the water of their river and found that it was clear, odourless and did not have any human or animal waste. However mining activity in recent years had led to the dumping of residual ore into the river threatening its fish life. The students reported this matter to their respective schools and the Municipal Corporation and urged them to take serious steps to check this problem.

Ingenious Traps

This photograph shows how an African tribe the Wagenia, build wooden scaffolding over the river Congo, from which they suspend cone shaped fish traps.

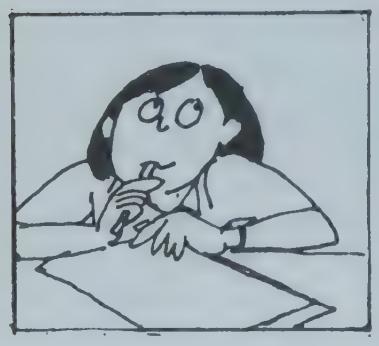
Photograph the way in which fish are caught in your local river, or perhaps you could make a chart of photographs, collected from books and magazines, depicting the different ways in which fish are caught in rivers all over the world.

Activity

GO BACK TO THE ORIGIN

Many of the products we eat - cucumbers, melons and fish, or those we use - water supply, clothes washed by the dhobi etc. come directly from our river or from its banks.

Who are the people who make this possible ?
How many hours a day do they work ?



How much do they earn ?

Where do they live ?

What do they do when the river floods /dries up ?

Interview one such person or family using the guidelines given below:

a) Set aside time for designing a questionnaire before you go out and interview.

b) Start by defining what it is that you want to find out. Write this out as a single sentence on the blackboard.

c) Then select the target group to be interviewed. How many people will you speak to and will their responses be very varied? Will you choose the people to be interviewed through a random selection or will you handpick them ?

d) Once you have decided these issues, you can start listing out all the possible questions to be asked.

Try and think of all possible responses/answers to each question. Is your question specific enough ? Is the information you are seeking really relevant to your study? Are the questions organized in the correct order?

e) Review your questions along with your group, and make sure that everybody has the same set of questions !

f) Now you need to focus on how you need to carry it out. Most questionnaires need to be preceded by building a rapport (friendship) with the individual being questioned.

g) Role play possible interviews and responses in the classroom. This will help you define your questionnaire even further. Now it is ready to be used in a field situation.

After these interviews, broadly group together those of you who have investigated related occupational/economic groups. Then present your material to the rest of the class using a variety of presentational techniques.

* Charades / Role plays (enact your interviews)
* Charts and audio visuals
* Open group discussion

PAGES FROM A STUDENTS DIARY

18th September.

A child working at a cremation ghat! I didn't believe it when ma'am told me, but today I met Satyendra at Nigambodh Ghat.

Satya looks like any other young boy of 13. He left his school in Jaipur some years ago to come to Delhi, to live with his uncle and work at Delhi's biggest cremation ghat ! Satya says that his father also was an Acharya, those Brahmins who can perform the last rites for the dead. (And just imagine I thought he must be a Chandala, an outcaste!)

Everyday at least 35 bodies are cremated here. I counted five myself while we were there. This is his daily routine, and at the present he is piling wood for cremations and collecting the ashes. Imagine the ashes can only be immersed in the Yamuna on the fourth day after the cremation.

He starts work at 7.30 am and finishes usually after 10 pm. I asked him if he wasn't scared with all the dead bodies around. "Earlier I felt scared of ghosts_ now I've become used to it, he says shrugging his thin shoulders. When I asked what he wanted to be when he grew up, he said wistfully, "A pilot".

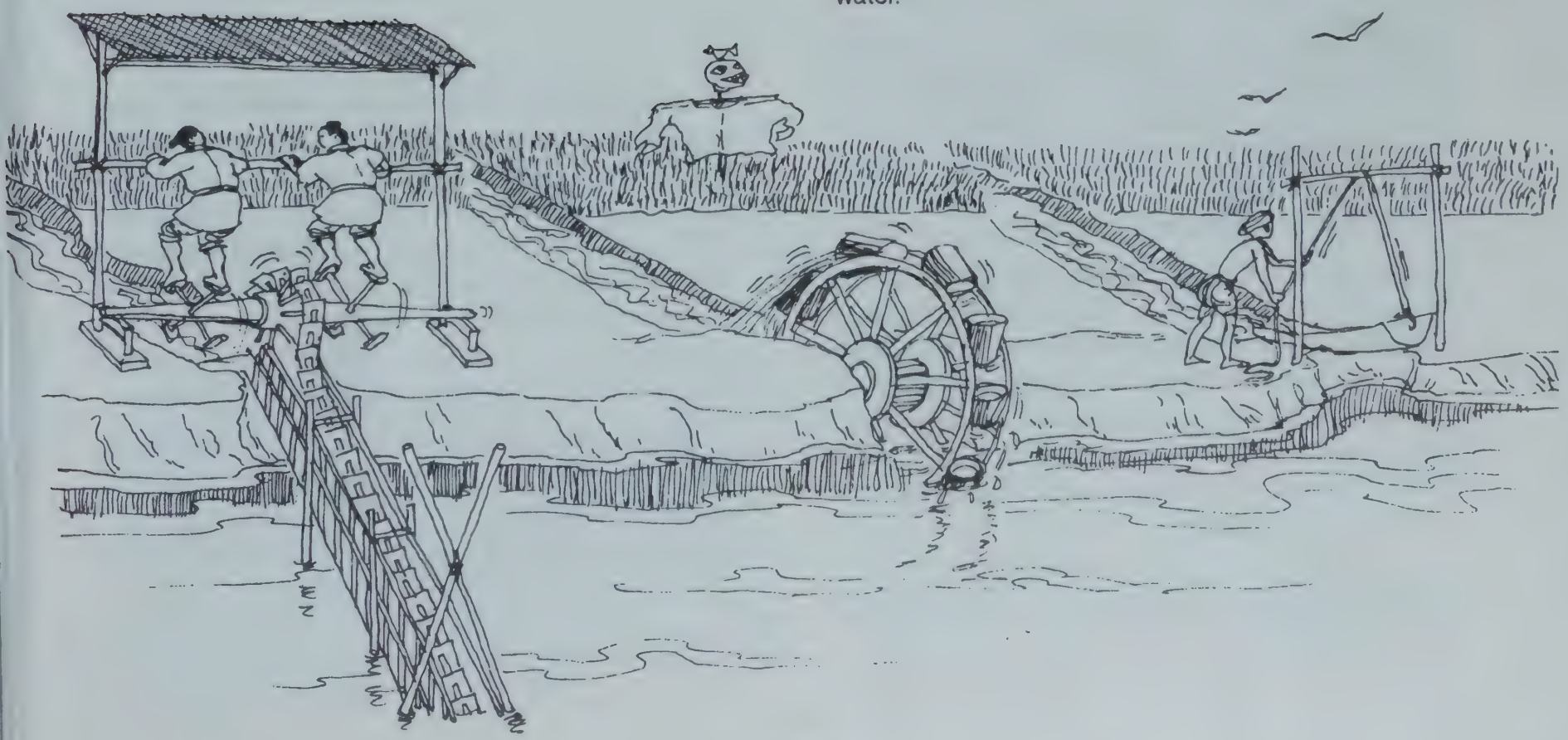
Activity

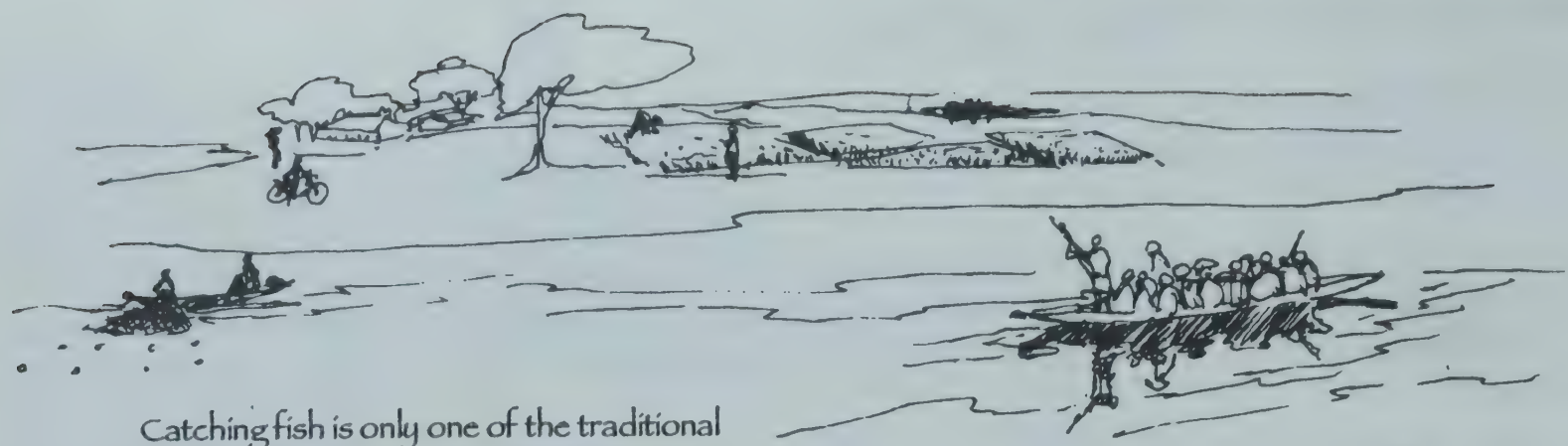
LOCAL TECHNOLOGY

Look at the illustrations given below that depict three different ways of lifting water from a river to the adjoining field.

The first is from China, the second is from Egypt and the third is from India, though many of these techniques are used elsewhere too.

Look along the banks of your river to see what simple machines and engineering techniques are used to lift water.





Catching fish is only one of the traditional
ways of making a living from the river.
Ferrying people
Washing clothes
Building boats and making nets
Carrying out religious functions
Practising agriculture on the banks
and when possible in the river bed
....are some of the others.

"At Varanasi the holy Ganga makes a curve like the crescent moon. The city faces and worships the rising sun. I arrived at Dashaswamedha, the most important ghat, well before the first flush of dawn. My boatman, Kashi, who takes his name from the city, was waiting for me. He rowed me out into the river.

As the sun rose it picked up the details in the cracks of the colossal flight of steps, brought out the texture of the palm-leaf umbrellas and revealed the weathered paint of the blocks of buildings, the stacks of temples, the rows of towers and the palaces of the Maharajas. Then I heard the cry of some recently arrived pilgrims: " Jai, Jai, Kashinath, Bolo Ganga Ki Jai." I turned my attention to their morning ablutions.

The brass vessels, the urns, pitchers in the hands of the bathers all glinted like gold and caught my eye. Ganga water was scooped up and lovingly poured back as the sun caressed each drop. It was cupped in the hands as they were lifted in prayer. Rose petals, garlands of marigold and sweets were offered to the mother river. A priest wearing a white dhoti and kurta appeared with a flaming oil lamp in his right hand, lifting it, circling it and lowering it over the Ganga. With his left hand he vigorously shook a brass bell. Then he blew on a conch shell. Nearby a bather said his prayers.

To describe the morning ablutions at Varanasi would fill an encyclopedia, as no two persons use the same gesture, the same prayer or the same name for a god. Ganga alone has 108 epithets and names and Shiva has 1008."

Raghu Rai, India Magazine

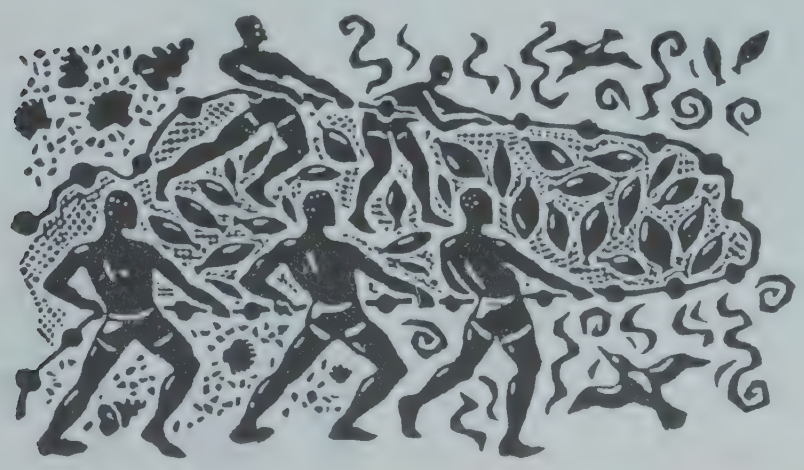
"But there were thousands of small boats dashing in and out amongst the anchored ships and the landing stage (the ghat) was crowded with the most colourful people, females bearing pots or jars on their heads, and children, resembling little black monkeys, astride on their hips; bhisties, or water-carriers, filling their bags from the turbid tide, well seasoned with coconut husks, defunct Brahmins, dead dogs, etc; bullocks, bearing huge skins of the same pure element; palankeen bearers, gabbing(to me) unintelligible abuse, in eager competition, pushing into the very river, and banging their portable boxes one against the other in their struggle to secure fares amongst the frequent arrivals from the shipping; baboos, parroquet-vendors, chattah-bearers, sailors, lascars, and adjutant-birds' - all were there. In fact, Europe and India `commingled ....in confusion."

This lively word picture describes a ghat in Calcutta over 150 years ago. It comes from a book 'Memoirs of Griffin' by Captain Bellew. 'Griffin' was a word used in Anglo-India to describe a newcomer to India.

Activity

RIVER WORDSCAPE

These two descriptive paragraphs, written 150 years apart, bring to life the bustle and activity of a riverfront. After visiting your own riverfront can you write as vivid a description - capturing sound and light, stillness and activity, prayer and commerce.....



Activity

ON THE WATERFRONT

In a similar way to using words to describe the busy activity on the waterfront, you could use 'visual' images...

This book itself offers a range of exciting visual possibilities. Look through the list of illustrations given below, to 'spur' your imagination along.

The illustrations in this column are **lino-cuts**, which means you first carve a design on a piece of linoleum, then you ink it and then you print it. The drawing on the opposite page uses **pen and ink.** To make drawings such as these you can either first 'sketch' the scene out in pencil, and then ink it in, or once you are more adept at the technique, you can directly draw with ink on paper.

On pg. 56 is an example of a Chinese **woodcut**, while an example from our own woodcut tradition of Kalighat(Calcutta) appears on pg. 71 'Woodcuts', as the name suggests, are images carved onto wooden blocks, which are then inked and printed. A single printing can be used - as in the Kalighat print, or a number of woodcuts can be printed in different shades one on top of the other, to create a woodcut print, like the Chinese one on pg. 56. An excellent example is by the famous artist from Bengal, Haren Das and appears on page 2. Our delightful and painstaking **miniature** traditions appears on pg. 79

From Mathura in U.P. comes the traditional form of **stencil** making. The fish on the title page of this book, and the peacock that is at the bottom of the 'Preface' are both vibrant examples of this craft.

Papercuts like those of the fish on pg.1 or of the bird on pg.19 display another technique that you could experiement with. Here all you need is a piece of black paper, a pair of scissors and a fertile imagination!

Ofcourse the riverfront has inspired many artists in our country to explore it in different mediums. Among the best known are Ramkumar's **oil paintings** and M.F. Husain's **graphic prints** on the theme of the Varanasi river front.

The Yamuna in Delhi helps thousands in the city make a living. Agriculture, mainly practised on the eastern banks and in the summer in the river bed, is the major occupation practised along the river. But in addition there are traditional occupations - those carrying out religious functions at the various ghats and temples on the banks, washermen and ferrymen, fishermen and scores of others...

DIARA LANDS

An interesting feature of the silt brought down by rivers is that once the flood waters recede, "khadar" or "diara" land becomes available to be cultivated. Million of inhabitants cultivate this no man's land on the various rivers of India.

In Assam, Bihar and U.P. alone we have about 2.64 million hectares of diara lands. The moods of the river dictate the lifestyles here: heavy damages to crops, property, lives and cattle are frequent. The unpredictability of the environment makes investment in this area impossible.

Gangs of criminals and self appointed absentee landlords are now keeping the diara lands under a vice like grip. Epidemics are rampant among both men and animals in the wake of floods here and there is a shortage of drinking water. Extreme poverty and a semi-nomadic existence are the features of the lives of those who inhabit this area.

River Nomads of Assam

Can you imagine a family choosing to stay along with its domesticated animals, on a raft made of banana stems 'inside' its flooded house? These are the river nomads of Assam who inhabit the islands (chars) in the Brahmaputra river. They welcome the annual floods. "Floods are our life, they sustain us. If they do not occur, who will make our soil fertile, multiply our fish population, strengthen the growth of deep water rice and above all, keep our poor environment clean?"

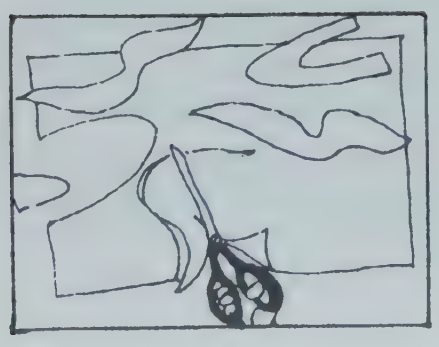
The chars(islands) that dot the 720 kms long course of the Brahmaputra in Assam, number more than 1200. Most of these island are concave in the middle, which makes their bowl safest for inhabitation. As the chars are often completely under water during high floods, dwellers build their homes on earthen or wooden platforms. While the Nepali immigrants here prefer 'chang ghars' built on bamboo, the Bangladeshi immigrants plaster their bamboo structure with mud. Each char is criss-crossed with a network of channels, and the houses come up in relation to this. This alignment allows the households to use the river water in the channels for washing, boating, and fishing - and encourages the growth of a logical, linear pattern of settlement that does not obstruct the ferocious current of flood-water.

The farming pattern here is very radical - involving multiple cropping and interculture. Keeping in mind the sweeping seasonal changes of the valley, a unique crop calendar has come into being. After the flood waters recede - lentil, blackgram and mustard, rapeseed can be cultivated till early December. Then Ahu rice is planted, and harvested in July just before the floods start.

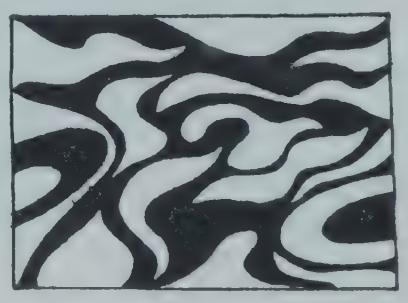
Material adapted from 'Down to Earth'

Activity

WATER PLAY PICTURE



Think of the way water flows and... creates various different shapes. Then take a rectangular piece of black or coloured paper and think of how you can cut it up so that you can capture this movement of water. Using a pair of scissors, cut the paper up. Then rearrange the pieces on a sheet of white paper till you feel there is an interplay of shapes. All of the coloured paper must be used, though you may rearrange the pieces. Stick the pieces down to complete your WATER PLAY PICTURE.



In India women provide 75%
of the labour for transplanting and
weeding rice,
60% for harvesting and
33% for threshing.

MAKING ENDS MEET

This job is for the women,
To stretch out a thin meal
In a poor country, water's
Needed to complete the deal.

Added to precious dal, and
Rice, it makes these grow,
It is the stuff her stick
Fingers knead into dough.

These are the tricks she's
Learnt, to eke things out.
But when water is scarce
A woman must go without.

That purple gem, madness,
Do you see it, coruscating
At her throat? It is worn
By women in queues, waiting.

At city water-pumps, pulling
Buckets from mud-filled wells.
And by the woman with nothing
Left for the child, for herself.

In her, the serpent swallows
Its own tail, endlessly, and
The lovely gold of her laugh
Trickles away, grey, stagnant.

All said and done, a poem
Is water in a woman's hands.

by Rukmini Bhaya Nair.

RICE CULTIVATION

Rice is a tropical monsoon crop which means its cultivation requires high temperature to germinate, bloom and mature along with heavy rainfall on the soil and sufficient ground water.

Wet rice cultivation i.e. rice grown for much of the time in deliberately flooded fields - is the most important source of food for much of this area. In fact wet rice farming is the dominant agricultural activity in south-east China, East India and parts of South-east Asia.

Growing rice is a complicated process that involves a lot of human time and hard labour. The first step, is to prepare the field for planting with a plough which is drawn by water buffalo or oxen. The use of a plough and animal power is one characteristic that distinguishes subsistence agriculture from shifting cultivation.

The next step involves flooding the ploughed land by either rainfall, river overflow or irrigation. Too much or too little water can damage the crop. Before the rice can be planted, dykes and canals must be repaired so that the required quantity of water is ensured.

Rice is transplanted into this soil from seedlings which are a month old. For three-fourths of its life the rice plant grows submerged in water. The rice plants are harvested by hand, usually with knives and the heads are threshed by beating them on the ground or treading on them barefoot. The chaff (husks separated from the seed by threshing) is winnowed in trays that allow the lighter chaff to blow away. If the rice is to be consumed by the farmer, the husk is removed by pestle and mortar, if it is to be commercially sold it is frequently whitened and polished. This removes nutrients but makes it more pleasing in appearance.

The Thanjavur district in Tamil Nadu is known as 'the rice bowl of India'.

THE SHRIMP

"The Shrimp : a tiny key to a giant treasure chest. A global market of 8,000 million US dollars. The golden egg is the tiger shrimp, a gourmet food across the world, priced at between Rs.260 -Rs.300 per kilogram!" It was the lure of unimaginable profits that resulted in a feverish increase in shrimp farming from 1992-95. Overnight saline sea water was pumped into farms along with shrimp seeds and imported nutrients, fertilizers, dead algae and shrimp shells. Very often this debris was just dumped into the nearest waterbody, which often turned out to be a water source for neigbouring farms. The greatest impact of course was on the paddy fields next door. But besides this, aggressive shrimp farming has resulted in the destruction of mangroves (see pg. 17), the effluents affecting inland and coastal fishing and the social consequences of sudden money.

Material adapted from 'Down to Earth'.

An interesting feature of social life on a river - is that most of the occupations - fishing, ferrying, climbing trees, farming - are carried out largely by those at the lowest end of the social scale. The attitudes of society towards them are reflected in the provebs at the bottom of this page. The marginal incomes most of these groups earn, are evident in the story of Ratnapandi, a date palm tree cimber given alongside.

THE COCONUT

The perfect fruit for all seasons.
In the Vedas,the coconut tree is known as the 'kalpavriksha' , a tree that supplies the necessaties of life. Originating in the Indo Malaya region, coconuts dispersed accross the tropics on ocean currents. The first person to describe a coconut to the Europeans, was the famous Italian traveller of the 15th century-Marco Polo. Today coconuts are cultivated in 83 countries of the world.
The coconut provides many things to many people. Other than drinking its water rich in potassium, its 'malai' (or flesh) is used in a lot of our cooking.We use coconut oil for cooking and for our hair, while the water is used for its medicinal properies in many parts of India.In Kerala not only is the flesh used in cooking, but even the coconut flower and it's stem are cooked as vegetables. Every part of the coconut tree comes in handy.The dried leaves are woven together to make thatching for houses, the husk yields coir used in making mats and baskets.From the coconut shell many decorative articles are carved. Coconut sugar can also be made from this fruit . Infact in Indonesia,they claim that there are as many uses for a coconut as there are days in the year!

THE RISKY CLIMB OF RATNAPANDI

RAMNAD (Tamil Nadu): Ratnapandi Nadar has what must rank as one of the tougher jobs in the world. He climbs fifty date palm trees daily, some of them thrice a day to tap juice for 'panaivellam' (date palm jaggery). That could mean 150 trips—up and down—trees that might be twenty feet in height. His work begins at 3 in the morning and lasts up to sixteen hours. He can earn as little as five to eight rupees a day.

On a lighter day, Ratnapandi has to attend to at least forty trees. Even if these were shorter ones, between fifteen and twenty feet, it means he could be climbing up to 5,000 feet a day. This is roughly equivalent to walking up and down a building of 250 floors daily, using the staircase. Only Ratnapandi isn't using a staircase. Nor even a ladder. He shins up using his hand and legs. While shinning up, he does not have even the protective hoop running around the tree that his counterparts in Kerala use. The risks accompanying him are also, quite obviously, far greater.

Once up a tree, Ratnapandi cuts into it near the base of the branches and pre-empts the fruit, by forcing open its bud. This allows the juice to flow into a pot that the tapper fixes below the incision. He replaces the pot every few hours, when it gets filled. When he goes up, Ratnapandi adds a powder derived from calcium carbonate to the flowing juice.

The powder is the catalyst that converts the extract into date palm jaggery. Without the powder, it would become toddy, since the process is other-wise identical. Rani, twenty-five, Ratnapandi's wife, boils and cooks the juice he collects in their huge open vessel. She then pours the paste into empty coconut shells where it solidifies into neatly shaped lumps of date palm jaggery. Most people find palm jaggery much sweeter and of better quality than cane jaggery.

That huge vessel they use is their only possession of any worth. They own no land and their hut has no belongings of even minimal value.

from *Everyone Loves a Good Drought*
by *P. Sainath*

'A fisherwoman will argue

even when she is dead'

'The washerman knows

who is poor in the village'

'When there is a robbery
in a dhobhi's house,
the neighbours lose their clothes'

Traditional proverbs of the 19th century

THE GIFT OF THE NILE

Egypt is the "Gift of the Nile", said the famous ancient historian Herodotus. The Nile brought glittering civilizations into being that were totally dependent on the huge harvests that followed the annual flooding of its banks. The rhythm of the Nile was the rhythm of Egyptian life. The annual rising of its waters set the calender of sowing and reaping with its three seasons: inundation, growth, and harvest. The flooding of the Nile brought down rich silt, in which crops were planted. The rising of the Nile, as regular and as essential to life as the rising of the sun, marked the Nile year.

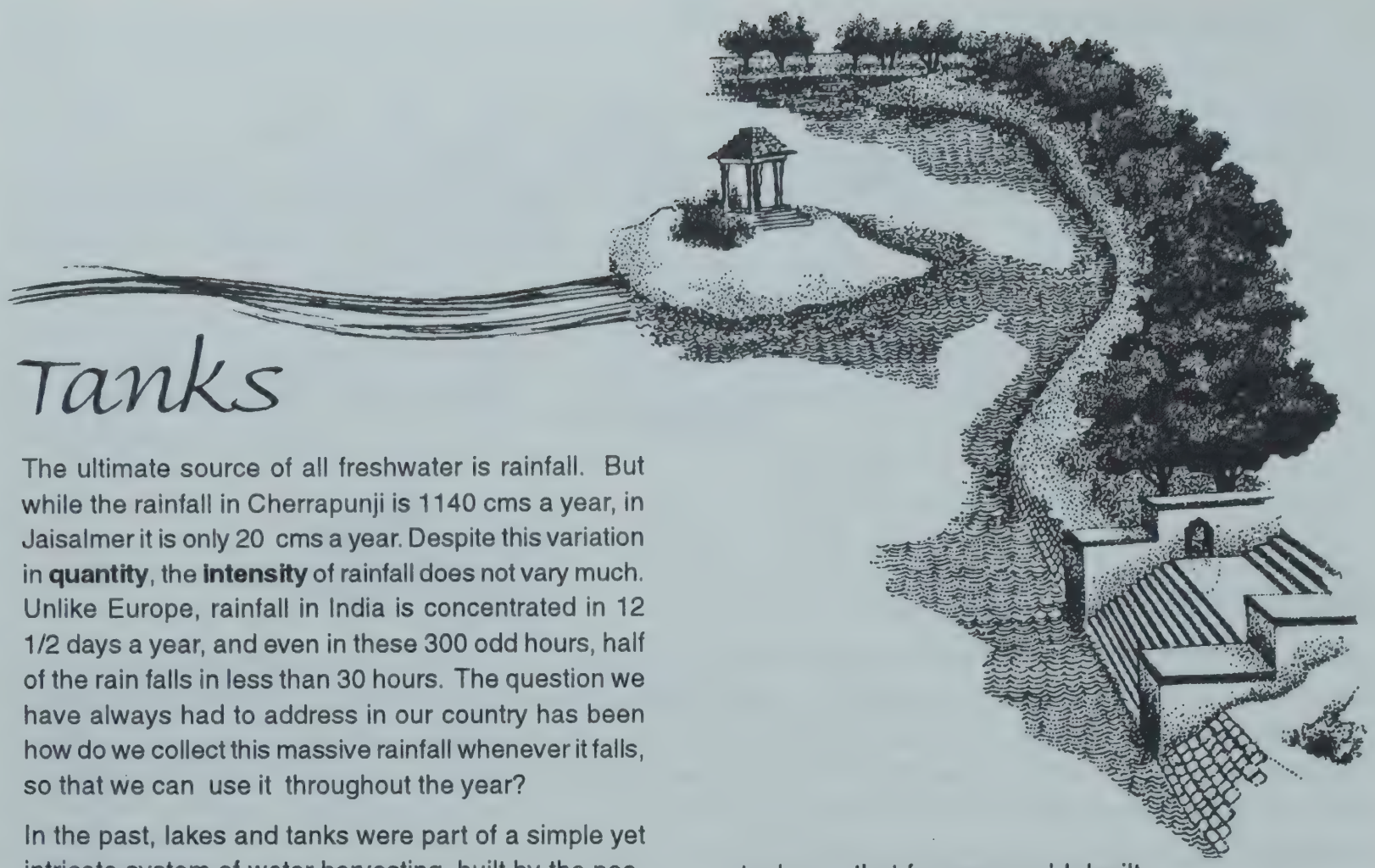
The Nile made possible the crops, the commerce, and the architecture of Egypt. It was also a freightway for the materials of colossal temples and pyramids. A granite obelisk of three thousand tons could be quarried at Aswan, and then floated two hundred miles down the river to Thebes.

Today, over 60 million people rely on this river. At the time of the Pharaohs it would have supported a population half that size. For much of the estimated 40 million years of its life, the Nile has been depositing silt into the delta. The silt here is so fertile that a cabbage needs to be picked up in both arms, and a cauliflower is so large that it has to be carried on the back!

The last Nile flood occurred in 1966-67 because after this the Aswan Dam brought irrigation around the year. But with it came an ecological backlash as well - while the dam has helped to double the food supply, a steady rise in the underground water table has threatened large areas with salinity, alkalinity and water logging.

Better three punches from a housewife,
Than three kisses from a fishwife.

Today in addition to the various traditional ways of earning a living from the river, new adventure sports on our country's rivers, have introduced a new means of making a livelihood. White water rafting, kayaking and canoeing are fast appearing on major Indian rivers.



Tanks

The ultimate source of all freshwater is rainfall. But while the rainfall in Cherrapunji is 1140 cms a year, in Jaisalmer it is only 20 cms a year. Despite this variation in **quantity**, the **intensity** of rainfall does not vary much. Unlike Europe, rainfall in India is concentrated in 12 1/2 days a year, and even in these 300 odd hours, half of the rain falls in less than 30 hours. The question we have always had to address in our country has been how do we collect this massive rainfall whenever it falls, so that we can use it throughout the year?

In the past, lakes and tanks were part of a simple yet intricate system of water harvesting, built by the people themselves, to store rainwater for their use through the year. These were a very important source of water for drinking and irrigation in India, both in urban and rural areas.

Cities which were not located near a perennial water source, depended entirely on building a tank in every possible catchment area. Elaborate systems evolved as new tanks were built in low lying areas to catch the overflow from those above them. Every drop was considered precious. In arid central and southern India, lakes and tanks in urban areas stored and supplied all the water for drinking and irrigation, and also helped in groundwater recharging. They built up soil moisture, developed greenery, reduced damage from flash floods and checked erosion.

Tank building was considered a noble deed but was never restricted only to the rich. An elephant driver, a village watchman and even a temple dancer built tanks at different times in our history. South India is particularly rich in tanks, with the Cholas, Hoysalas and Vijaynagar kings paying great attention to irrigation (see adjoining box item). By 1881, Karnataka had one tank for every 39.5 sq. Kms. The beneficiaries paid for the maintenance of the tanks and often formed 'panchayats' to lay down rules for the use of water, and its equitable distribution. The management of such tanks was usually vested in the hands of Harijan villagers, who because of being landless themselves, would have no personal stake. In Karnataka, festivals were organised around tanks, so that farmers could desilt the tanks and clean them so as to maintain their original capacity. This system of water harvesting made the villagers totally self reliant.

Traditionally, townships in south India were centered around temples. The temple tanks were protected, and had wells located in them serving as a link with aquifers.

Tanks did not however suit the British system of governance. "Their objective was resource extraction. As land revenue from each village was assured through a well developed `ryotwari' and `zamindari' system, they knew that the construction of tanks would not enhance revenue," says Somashekhar Reddy, author of `Forfeited Treasure'.

So instead of community managed indigenous water systems, like tanks and wells, which deteriorated after they stopped receiving state patronage, the emphasis shifted to diverting and pumping river water through projects like the Punjab and Deccan Canals. And India's present obsession with dams and other large scale water projects took root.

By the 1860's, Bangalore had evolved an intricate system of harvesting rainwater and very little was allowed to go waste. Most tanks had been built in the pre-British days. A linking chain of such tanks was created in each region. But by the middle of this century, the water crisis had become so acute that a committee suggested water hauling from the Cauvery.

Over 500 years ago, a Portugese priest described the building of a tank in the Vijaynagar kingdom:

"The King, Krishna Devraya made a tank there, which has a width of a falcon shot (a shot from a falcon, an old piece of artillery) and it is at the mouth of two hills, so that all the water which comes from either side collects there; and, besides this, water comes to it from more than three leagues by pipes. In the tank I saw so many people at work that there must have been fifteen or twenty thousand men, looking like ants, so that you could not see the ground on which they walked, so many there were.

This King also made in his time a lake for water, which lies between two very lofty 'serras'. But since he had no means in the country for making it, nor anyone who could do it, he sent to Goa to ask the Governor to send some Portuguese masons, and the Governor sent him Joao della Ponte, a great worker in stone, whom the King told how he wanted the tank built. Though it seemed to this man ('mestre', modern 'mistry') impossible to be made, nevertheless he told the King he would do it and asked him to have lime prepared, at which the King laughed much, for in his country when they build a house they do not understand how to use lime.

He made a bank across the middle of the valley so lofty and wide that it was a cross-bow shot in breadth and length, and had large openings; and below it he put pipes by which the water escaped, and when they wish to do so they close these. By means of this water they made many improvements in the city, and many channels by which they irrigated rice-fields and gardens, and in order that they might improve their lands he gave the people the lands which they irrigated by this water free for nine years, until they had made their improvements, so that the revenue already amounts to 20,000 'pardaos'.

From the Narrative of Domingos Paes
written probably between A.D. 1520-22

HEBBAL LAKE

The Hebbal lake is one of the oldest man-made lake systems in Bangalore, with a wide expanse of water covering about 182 acres. It was created in 1573 by Kempe Gowda-I. Its water was utilised mainly for the irrigation of the adjoining paddy fields and as drinking water. It was home to over 70 species of birds including migratory birds from the Himalayas and Central Asia. It also boasted a diverse fish population. But as the urbanisation of Bangalore proceeded at a feverish pace, the once pure and pristine waters became contaminated and Hebbal lake began to disappear.

About 8 to 10 lakh litres of sewage flow into the lake every day in addition to the industrial discharge from electronic, battery, textile and other industries. Another unique problem is the accumulation of waste oil and grease which are washed into the lake from surrounding garages. The water of the lake is now dark green and eutrophication is occurring due to excessive sewage contamination and because about 75% of the lake is under hyacinth cover. The tank bed has risen due to the deposits of sewage sludge and dead hyacinth. Oil and grease form a film over the water surface blocking light penetration. All this has made the lake waters unsuitable even for irrigation. The cultivation of paddy downstream had to be abandoned for this reason. There has been a loss in the diversity of water fowl, from more than 70 species in 1983 to less than 20 at present.

About 25 years ago, Bangalore had 262 lakes. Now the number has decreased to a dismal 81. Most of these are plagued with problems similar to those of Hebbal .

Samples of water from this lake and the Kempambudi lakes as well as from the Ulsoor and Sankey tanks were collected and tested by school children of classes VII and VIII in Bangalore. NGOs and the Urban Forestry wing also helped them in this. In addition, the children organised campaigns in nearby localities to create an awareness amongst citizens to keep these water bodies clean and prevent them from being polluted.

Similar campaigns and water testing activities spearheaded by school children have been successfully conducted in other cities and towns all over India : Bhopal, Indore, Pune, Chennai, Hyderabad, Trichur, Shimoga, Lucknow, Delhi, Varanasi and several others. Teachers and voluntary organisations have helped students select the parameters to be tested, devise kits, organise trips and prepare reports.

History

"Rivers are roads which move and which carry us wither we desire to go."

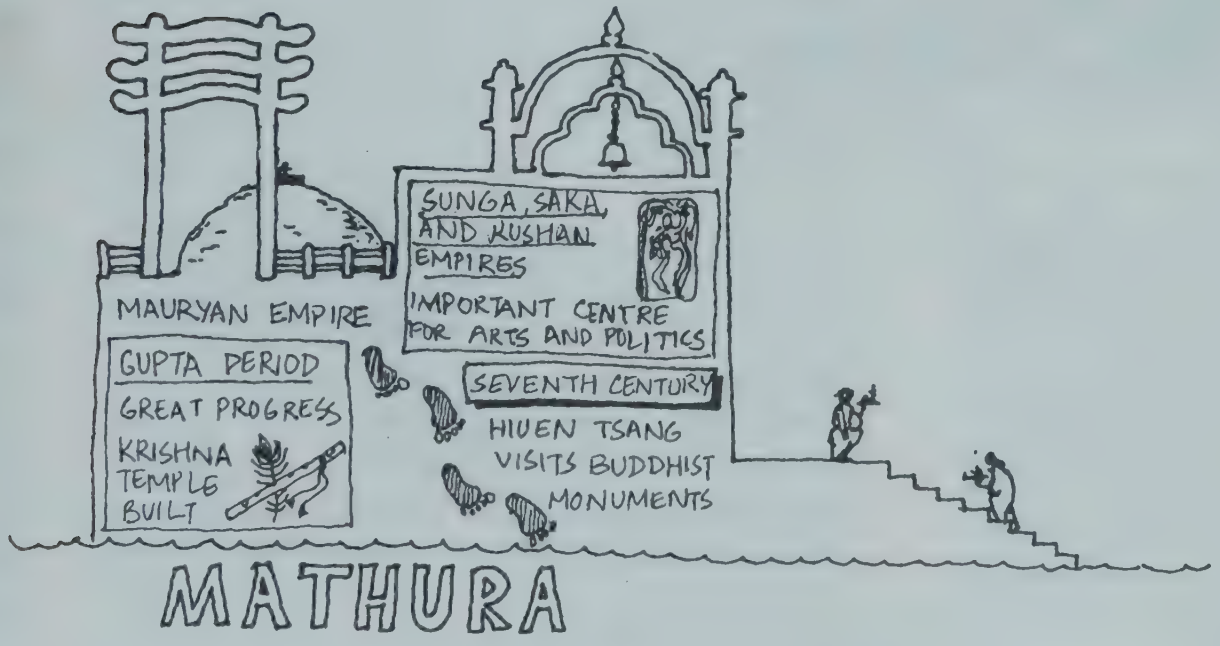
Pensees - Pascal

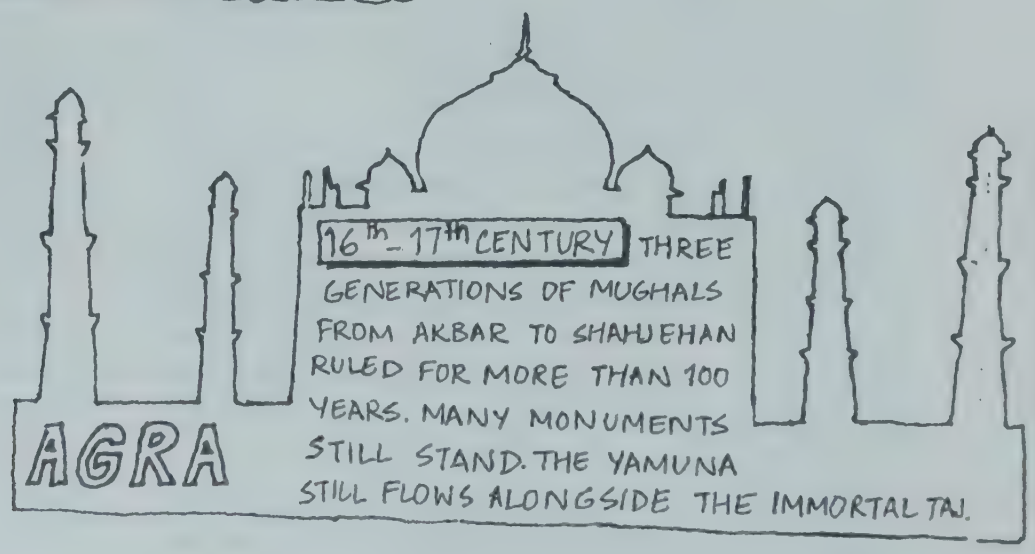
A trip down any major river of the world is an epic journey. The changing scene of people, habitats and monuments located along the river reflect the various stages and processes of human civilisation. To travel down a river is both a link with the past, and a glimpse into the future.

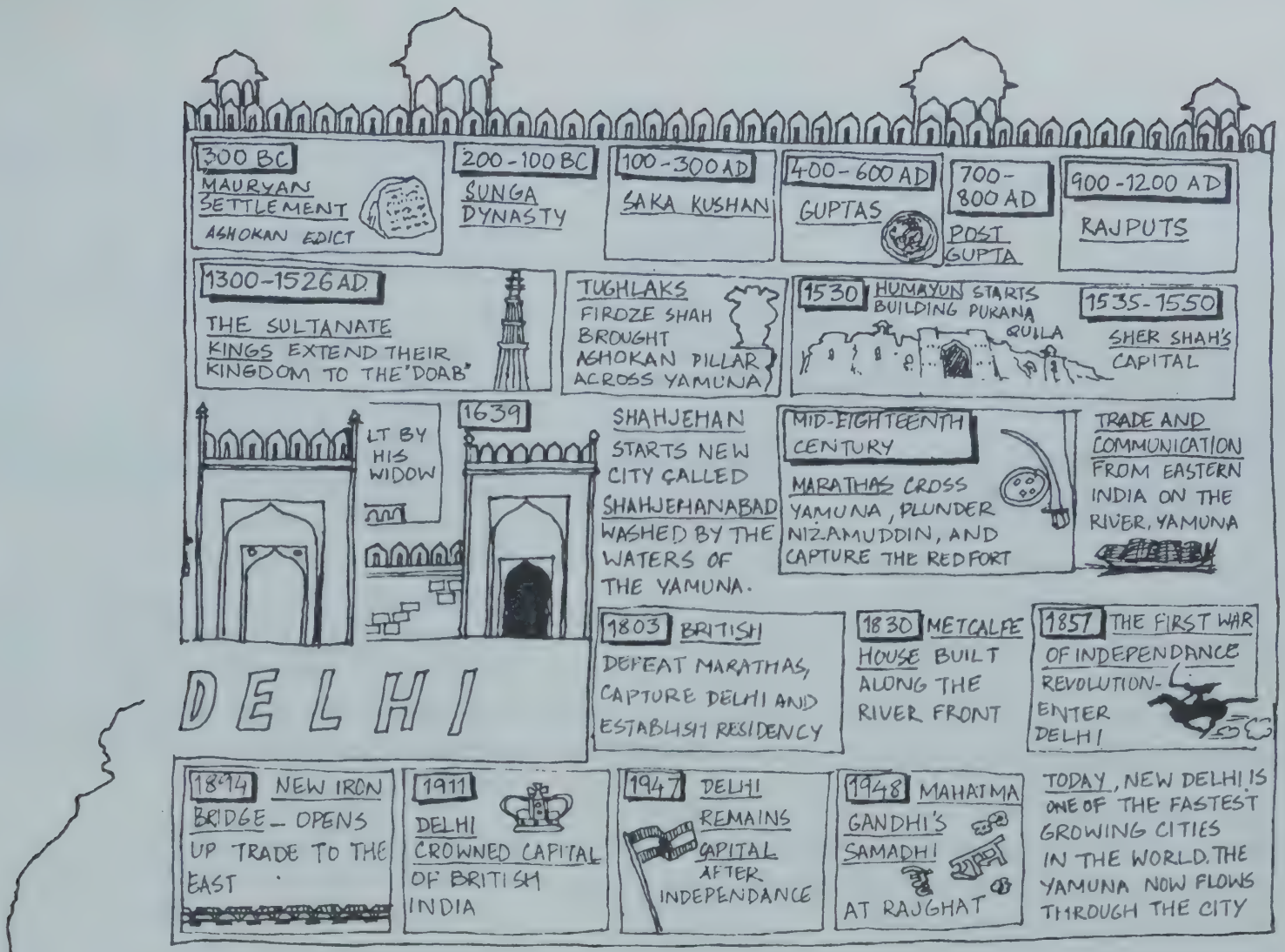
The Yamuna has attracted successive human settlements from time immemorial. Excavations by the Archeological Survey of India at the site of Delhi's Purana Qila (this area was originally along the old course of the Yamuna) reveal habitation from the Pre-Mauryan age, to the Pre- Mughal era.

Let us take the example of the four main cities located along the Yamuna, i.e. Delhi, Mathura, Agra and Allahabad. The banks of the river in these areas have witnessed a continuous historical process. They remain important even today, for along the river live people who are participating even now in the making of history.

Here is a time line which highlights the history along the Yamuna in Delhi, Mathura, Agra and Allahabad.




16th-17th CENTURY THREE GENERATIONS OF MUGHALS FROM AKBAR TO SHAHJEHAN RULED FOR MORE THAN 100 YEARS. MANY MONUMENTS STILL STAND. THE YAMUNA STILL FLOWS ALONGSIDE THE IMMORTAL TAJ.
AGRA


300 BC
MAURYAN SETTLEMENT
ASHOKAN EDICT
200-100 BC
SUNGA DYNASTY
100-300 AD
SAKA KUSHAN
400-600 AD
GUPTAS
700-800 AD
POST GUPTA
900-1200 AD
RAJPUTS
1300-1526 AD.
THE SULTANATE KINGS EXTEND THEIR KINGDOM TO THE 'DOAB'
TUGHLAKS
FIROZE SHAH BROUGHT ASHOKAN PILLAR ACROSS YAMUNA
1530 HUMAYUN STARTS BUILDING PURANA QUILA
1535-1550
SHER SHAH'S CAPITAL
1639
LT BY HIS WIDOW
SHAHJEHAN STARTS NEW CITY CALLED SHAHJEHANABAD WASHED BY THE WATERS OF THE YAMUNA.
MID-EIGHTEENTH CENTURY
MARATHAS CROSS YAMUNA, PLUNDER NIZAMUDDIN, AND CAPTURE THE RED FORT
TRADE AND COMMUNICATION FROM EASTERN INDIA ON THE RIVER, YAMUNA
DELHI
1803 BRITISH DEFEAT MARATHAS, CAPTURE DELHI AND ESTABLISH RESIDENCY
1830 METCALFE HOUSE BUILT ALONG THE RIVER FRONT
1857 THE FIRST WAR OF INDEPENDANCE REVOLUTION- ENTER DELHI
1894 NEW IRON BRIDGE - OPENS UP TRADE TO THE EAST
1911 DELHI CROWNED CAPITAL OF BRITISH INDIA
1947 DELHI REMAINS CAPITAL AFTER INDEPENDANCE
1948 MAHATMA GANDHI'S SAMADHI AT RAJGHAT
TODAY, NEW DELHI IS ONE OF THE FASTEST GROWING CITIES IN THE WORLD. THE YAMUNA NOW FLOWS THROUGH THE CITY
DELHI
MATHURA
AGRA
R. Yamuna
R. Ganga
ALLAHABAD
ALLAHABAD
KNOWN AS PRAYAG IN ANCIENT TIMES, THE CITY STANDS AT THE CONFLUENCE OF THE GANGA AND THE YAMUNA
243-232 BC
ASHOKAN PILLAR HIGHLIGHTING RELIGIOUS AND COMMERCIAL IMPORTANCE
HIUEN TSANG AND KING HARSHA-VARDHANA VISIT PRAYAG. THE KING GIVES AWAY HIS WEALTH
AKBAR RENAMES THE CITY "ALLAHABAD" OR "THE ABODE OF GOD"
20th CENTURY
A MAJOR CENTRE OF THE INDIAN NATIONAL MOVEMENT

Activity

CREATE YOUR OWN CIVILIZATION

Archaeologists carry out excavations with a view to reconstruct our ancient histories and civilizations. Examining what is buried in layers of earth gives us the opportunity to learn about people and cultures of the distant past. Surviving objects of stone, metal, pottery and brick tell tales that bring many history books alive.

If archaeologists excavated our civilizations 1000 years from now, what do you think they would find? Discuss this along with your group and identify ten symbols of our civilization that you feel will form a comprehensive picture of ourselves.

Just as archaeologists have been able to piece together the past from excavating items such as coins, pottery, pieces of sculpture etc, so will the symbols you choose communicate an understanding of our times and our environment to future archaeologists.

After a group discussion, individually draw up a list of three objects that you feel must be included. Let all members of your group share their lists. Now collectively draw up a list of only ten items.

In drawing up your final list why do you think that certain items were repeated in several lists? What does this indicate of our civilization?

Collect these ten items and decide when and where you will 'bury' them. Will where you 'bury' them make any difference to their interpretation in the future? Should they all be 'buried' together or should they be 'buried' at different places according to their function? Once you have decided on the answers to these questions, go ahead with the 'burial' of these items.

Get another group to 'excavate' and analyse their findings. This group should not have been involved in the process detailed above. Let the second group (the archaeologists) write up their report and share it with the first group (custodians of the earlier civilization).

DIGGING UP THE PAST

The study of the past using documents and inscriptions as evidence is the subject of history, the study of the past using objects and other excavated (dug up) evidence as its main source is called archaeology.

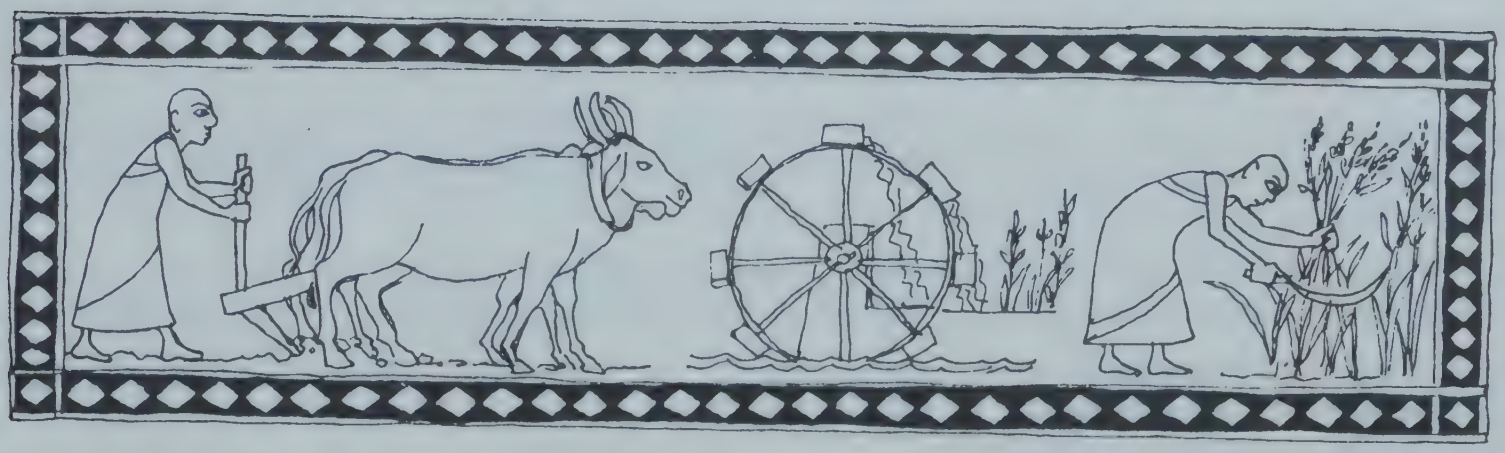
Archaeology helps us to study societies that existed even before the invention of writing. Almost anything that is excavated (dug up) sheds light on the past (as we can see clearly in the adjoining activity !) The foundation of buildings, the remains of tools, animals and plant remains that tell of the food eaten in the past, just as pollen, herbs and the remains of trees and plants, indicate the type of climate and vegetation at the time. After the birth of writing, archaeology supplements the knowledge we gain from written history.

Of course the most obvious reason for things to get buried (and later excavated) is the burial of humans and animals. Another reason for burial is to dispose of household garbage. In the past, as today in our own country, garbage was dumped in a hole in the ground. As a result, often with the garbage, pieces of pottery got buried. Another form of burial is that of buried treasure. Remember banks and safety deposit boxes didn't always exist, and for many sociieties the safest place to keep valuables was in a hole in the ground !

Natural catastrophes such as volcanic eruptions can bury a complete site as in the case of Pompei (Italy) or Borubudur (Indonesia). But most often, it is the natural process of decay and renewal that buries most of the past. Old buildings give way to new ones, flyovers and bridges are built, often complete cities and sites are abandoned due to a multiplicity of factors - no water, flood, disease, political decision - and are left to the mercy of the elements.

The excavation - or the unearthing, examination and recording of an archaeological site - is like a post mortem operation. Today archaeologists are assisted in their detective work by computers, carbon 14 dating techniques, radar, infrared photography, chemical analysis and video recording.

Archaeology, like history, helps us better to understand the past, and this understanding gives us a clearer perspective on the present, and on the future.



CHANGING THE COURSE OF HISTORY
RIVER VALLEY CIVILIZATIONS

From pre-historic times river waters have influenced human beings and helped them to find their bearings. It was along rivers that nomadic people first settled. They learnt how to control land and water and develop agricultural systems.

Rich alluvial soil along the rivers were the initial sites for developing many varieties of grain seeds. The availability of water and the cultivation of plants led people to domesticate animals. Soon people began to settle along the river banks and establish the first farming communities.

These settled communities contributed to the future development of civilization and the social revolutions that followed arose from decisions made in these river valley settlements.

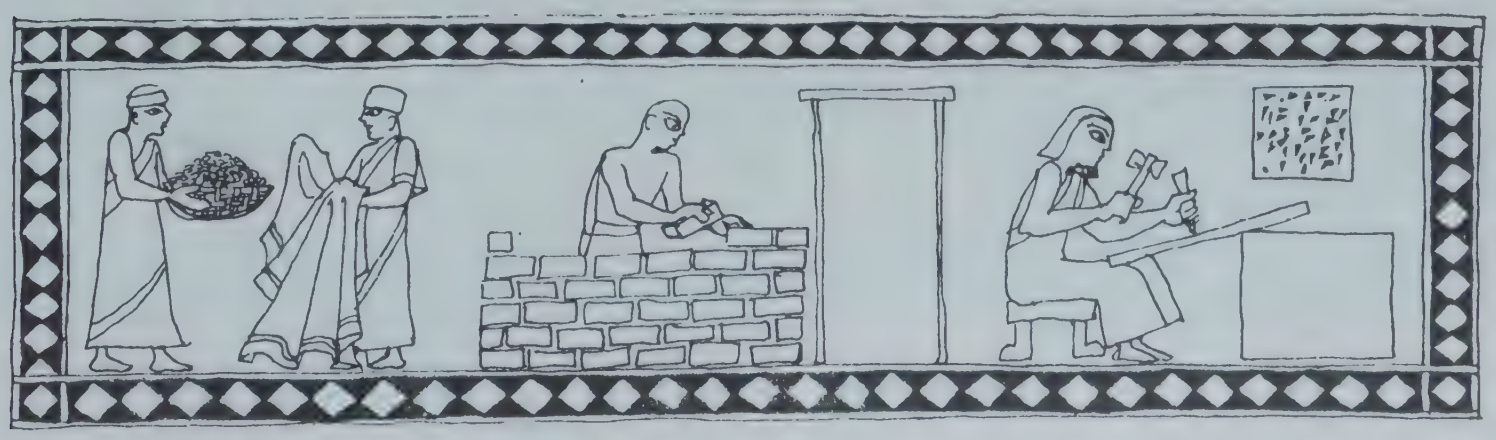
Riverside settlements gave rise to surplus agricultural produce that in turn led to trade and the division of labour. Artisans and builders then came on the scene. Soon farming settlements evolved into densely populated urban societies.

Around 4500 BC, the land between the mighty rivers of the Tigris and the Euphrates saw the emergence and flourishing of one of history's great river civilizations - the Sumerian and Babylon civilizations.

Here the people learnt to irrigate fields and drain swampy areas. They learnt how to propagate their seeds and invented the plough. Later, better houses were built by shaping clay bricks from the river mud. A settled community made innovations in the arts of writing, mining and smelting basic metals like copper and silver.

Many legendary cities came up along these two rivers and survived for thousands of years. One such city was Babylon, of which we have historical proof from 2400 BC.

Ironically, the agricultural and irrigation systems that saw the flourishing of this civilization became one of the environmental reasons for its disappearance. Lack of drainage caused the water table to rise, leading to water logging and salination of the soil. This erosion soon destroyed the ability of the valley to nurture plant life, and provide for the people.



PAGES FROM A STUDENTS DIARY

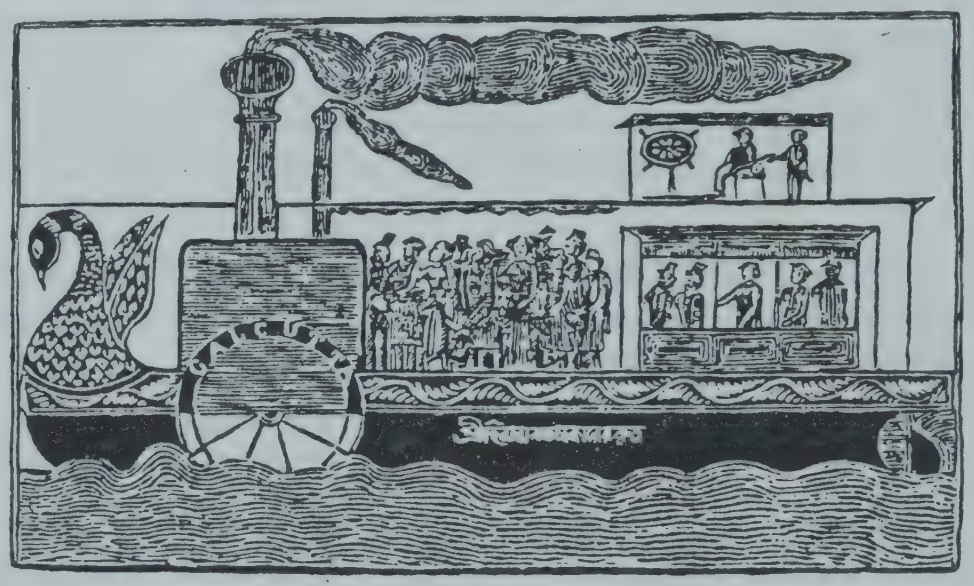
The wall magazine that we had put together on the history of our river front overflowed with a lot of material, some of which we had collected, and others that we created.

From reading Delhi's Gazette to other books on Delhi's fascinating history to fabulous books on art works: we collected a vast amount of information. This went into our wall magazine in the form of prose pieces, poems, maps, drawings and photographs. With these we filled the longest walls of the school !!

Contrary to our expectations re-visiting the great monuments on the banks of the river was a fun filled outing. The stone walls of the Purana Qila, Ferozshah Kotla and the Red Fort came alive as we now knew their stories.

On the way back in the bus we all thought of doing a play on the history of our river. It should be fun and I'd love to be Shahjahan. But where will we get the time ? What with projects and chemistry and tests coming up.

P.S. A friend of mine who is a wizard with her camera has already made up her mind to create a photo album of all these monuments. She wants to highlight her work with captions! I'm looking forward to reading them.



BELIEVE IT OR NOT

Archaeologists now believe that at the time of the Indus civilization, the Yamuna did not flow into the Ganga, nor the Sutlej into the Indus. Instead they flowed into the Ghaggar (currently a small seasonal river that emerges from the Sivalik foothills near Chandigarh) to make it a mighty perennial river that flowed straight into the Arabian Sea—probably the much worshipped Saraswati of Vedic times.

• • • • •

Satellite uncovers ancient Arabian River!

The "Kuwait River" had water that flowed in it some 5000-10,000 years ago.

Studying the latest remote sensing images from the sky, geologists have found a dry river bed which is 850 km. long and at some places is 5 km. in width.

It starts in the mountainous region of western Saudi Arabia ending in a big delta that covers two-thirds of today's Kuwait. The bed is covered by desert sands.

The channel that got covered by blowing sands (when the region started drying up) may contain remains of pre-historic settlements, flora and fauna from the time before the river dried up!

More research and study is being conducted to study the rocks and channels that run along a geological fault - for there may be trapped ground water, even though several metres deep!

Activity

CREATE YOUR OWN STORY BOOK

The historical events that have taken place on your river make a fascinating story and can be presented effectively in the form of a flip chart.

a) Collect information through reading books, magazines and newspaper articles, carrying out interviews.....

b) Recycle an old calendar by using it as a flip chart.

c) Write your story, divided into 12 parts, on the blank pages of the calendar.

d) Illustrate the text with 11 drawings. Stick these on the printed pages of the calendar.

e) On the 12th printed sheet of the calendar stick a drawing of a map of your river from its source to its end. Trace it out from a large map of India. Develop your own legend for your river map. This should include items such as scale, symbols, colour codes and NS directions. The keys of all your legends should be sharp and clear. Depict all the historical events/monuments/ settlements along the course of the river on your map. Remember to indicate towns, major villages as well as special features such as dams, bridges, tribal habitats, special agricultural produce, etc.

Show this inexpensive audiovisual presentation to people in your neighbourhood.

The continuous flow of water and the hectic activity on a river front possess a history of their own. The river has many tales to tell, which constantly change with the passage of time. Whenever one sits on the banks of a river, one wonders that though life and people and their histories on this very bank keep changing, the same waters keep flowing through the ages. This reflection makes one experience the continuum of history.

Your own river and the river front is a part of your own history and heritage. A history you can participate in to gain a greater perception of how what happens today, affects the future.

• • • •

"There would be merchant ships flying the flags of many countries. Lean, well-trimmed American vessels which brought great blocks of ice in their holds. Chinese ships, with an eye painted on either side, so that the vessels could see their way. Great awkward country boats laden with produce; the green goose-shaped budgerows used by Europeans for river travel; and 'airy little bauleahs, with their light venetian'd rooms, which seem fitted for the water-bowers of lovers on some of the lakes of those sunny isles which poets are wont to sing of, and where the breezes are never stronger than can be borne by silken sails. Behind all these, the lines of stately mansions reposing under the still calm sky, like some Grecian capital of old, bespoke the City of Palaces, CALCUTTA - the proud metropolis of British India!"

.....Memoirs of Griffin, London 1843

Activity

MEANDER ALONG

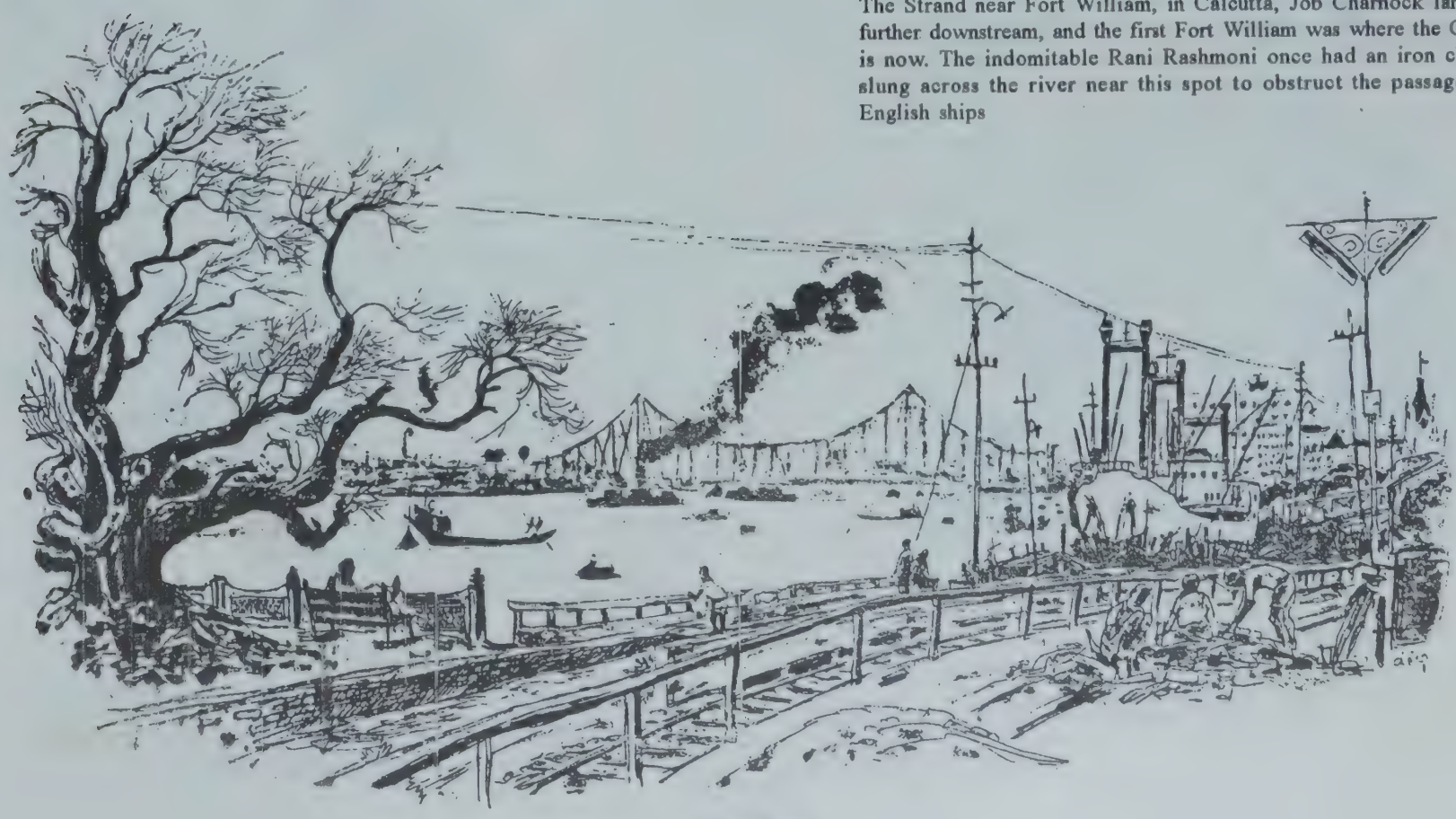
A walk along your river front will enable you to see for yourself all the various activities that take place along the river. From human settlements on the banks to travel up and down the river, in a variety of boats.

Why do people travel? Is it for commerce, carrying cargo, following a social custom or only for entertainment? What kinds of boats are in use today? Do these boats add to the wealth of the entire city or only of some people?

Draw or photograph the different types of vessels plying on your river. Find out from history books what the designs of boats used in the past on your river were. Sketch or photograph these from the books. How did the technology used in each age determine the design : from only using wind power, to wind and manual power, to steam, to fuel to machinery. Make a collage of your sketches along with photographs of boats on your river, both in the past and at present.

THE STRAND

The Strand near Fort William, in Calcutta, Job Charnock landed further downstream, and the first Fort William was where the GPO is now. The indomitable Rani Rashmoni once had an iron chain slung across the river near this spot to obstruct the passage of English ships



Throughout history, river routes opened up communication channels that in turn, changed history. In many respects people depended on these "liquid roads" right from the time of the ancient river valley civilizations. Much later, with the beginning of western colonial expansion, rivers were used by Europeans as routes to explore unknown continents. The Industrial Revolution ushered in the movement of raw materials, manufactured goods and the expansion of trade links on these same river routes.

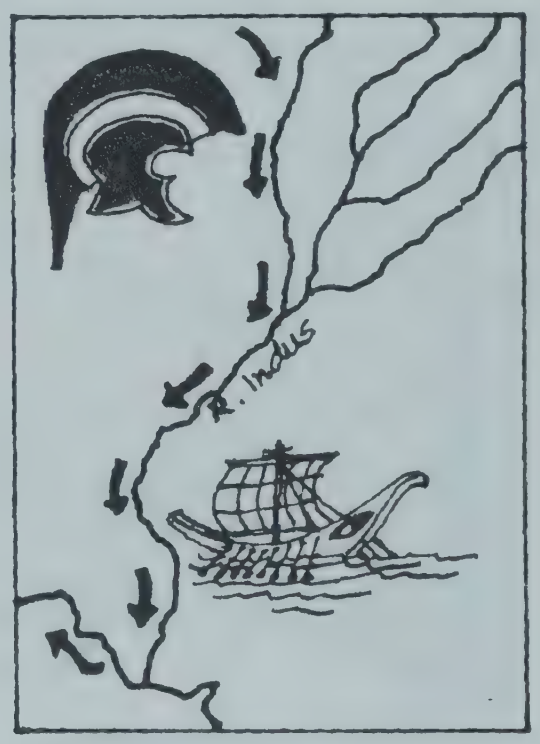
Here are seven examples of travel on rivers that have strongly influenced the history of their respective lands.

The Yangtze is full of steamboats, junk boats and tiny fishing boats. It has been the life line of China's commerce and trade from ancient times till today.

Two-thirds of all Russian inland freight is carried by the Volga and its tributaries.

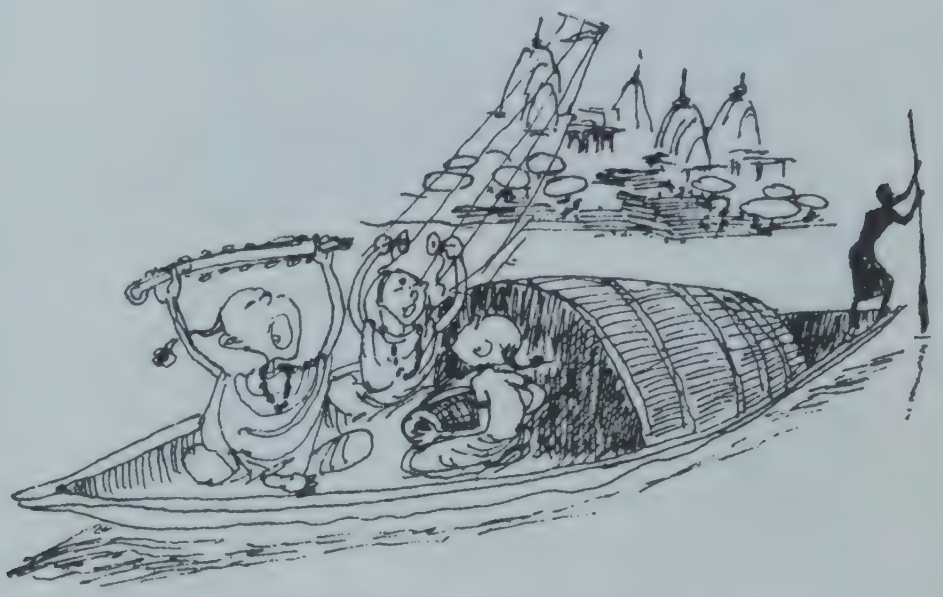
Only when the last fish is caught
The last buffalo, killed,
The last river, polluted
And the last tree, felled
Only then will mankind realise
That he cannot eat money.

Cree Indian saying



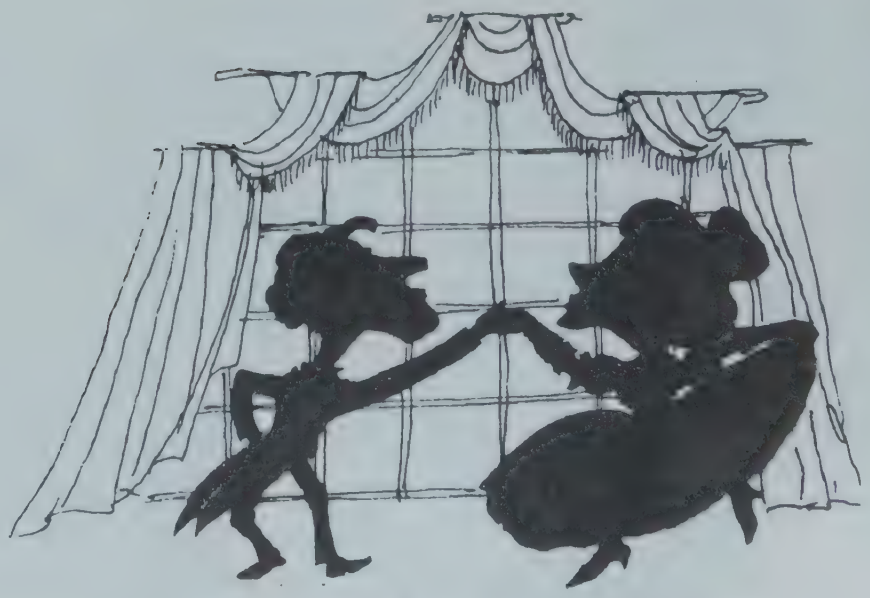
In 326 BC, weary and burdened with mutiny, Alexander led his troops home, travelling by river boats down the Indus towards the Indian Ocean. He then turned West along the coastline before re-entering the lands of Iran.

The history of travel on the Mississippi river is the history of the U.S.A. ... from early settlers to the legendary characters of Tom Sawyer and Huckleberry Finn to the beginning of Jazz music.



Pilgrims in India have for centuries travelled on the Ganga in rafts, homemade boats, sail boats and steamers.

Adventurers called 'bandeirantes' navigated the mighty Amazon to plunder the resources of the rain forest in South America.



The famous waltz "Blue Danube" by Strauss is an excellent example of the central role the Danube has played in the cultural history of Europe.

The Godavari and the Krishna Rivers

The Godavari and the Krishna, their double delta, their river valleys, their distributaries and waterways were of paramount importance in determining the land use patterns that influenced the socio-political history of South India.

Both the Godavari and the Krishna rise in the Western Ghats and flow eastward across the Deccan plateau. They flow 100 kms apart, receive many tributaries, and then discharge themselves into the Bay of Bengal, through two delta formations that spread over a million acres with a rich eco-sytem of mangrove swamps alternating with high sand dunes. The Godavari fans out into a 'seven mouth' delta that gets completely flooded during the wet season resulting in rich alluvial fields. Human fossil remains and primitive stone tools found in the terraces of the river valleys of the Godavari suggest that humans have inhabited South India from a very early period.

It is interesting to note that in ancient Tamil literature of the Sangam period, (Pandya kings of South India, patronised many writers and poets who worked in the academies, known as 'sangam' in Tamil, at Madurai) there is a great emphasis on the five eco-types. These types, referred to in several texts are, mountains, forests and pastures, dry barren lands, the valleys of the great rivers, and the coast.

The fourth type, that of the river valleys was the most important. Even earlier than the Sangam texts the Rigveda mentions: 'They made fair fertile fields, they brought the rivers. Plants spread over the desert, water filled the hollow.'

Over the centuries many kings developed this delta region by constructing canals, tanks and wells. Besides inviting farmers to live here, this region was also settled with artisans and brahmins.

The Godavari was the river that divided northern India and southern India and like the river Indus had considerable influence on the history of this area especially from 8th century A.D.

There was a close connection between the growth of population and agriculture here, so that this area became a nucleus for all the regional kingdoms of South India. From pre-historic excavations to modern times, the lands between the two rivers have seen the unfolding of history.

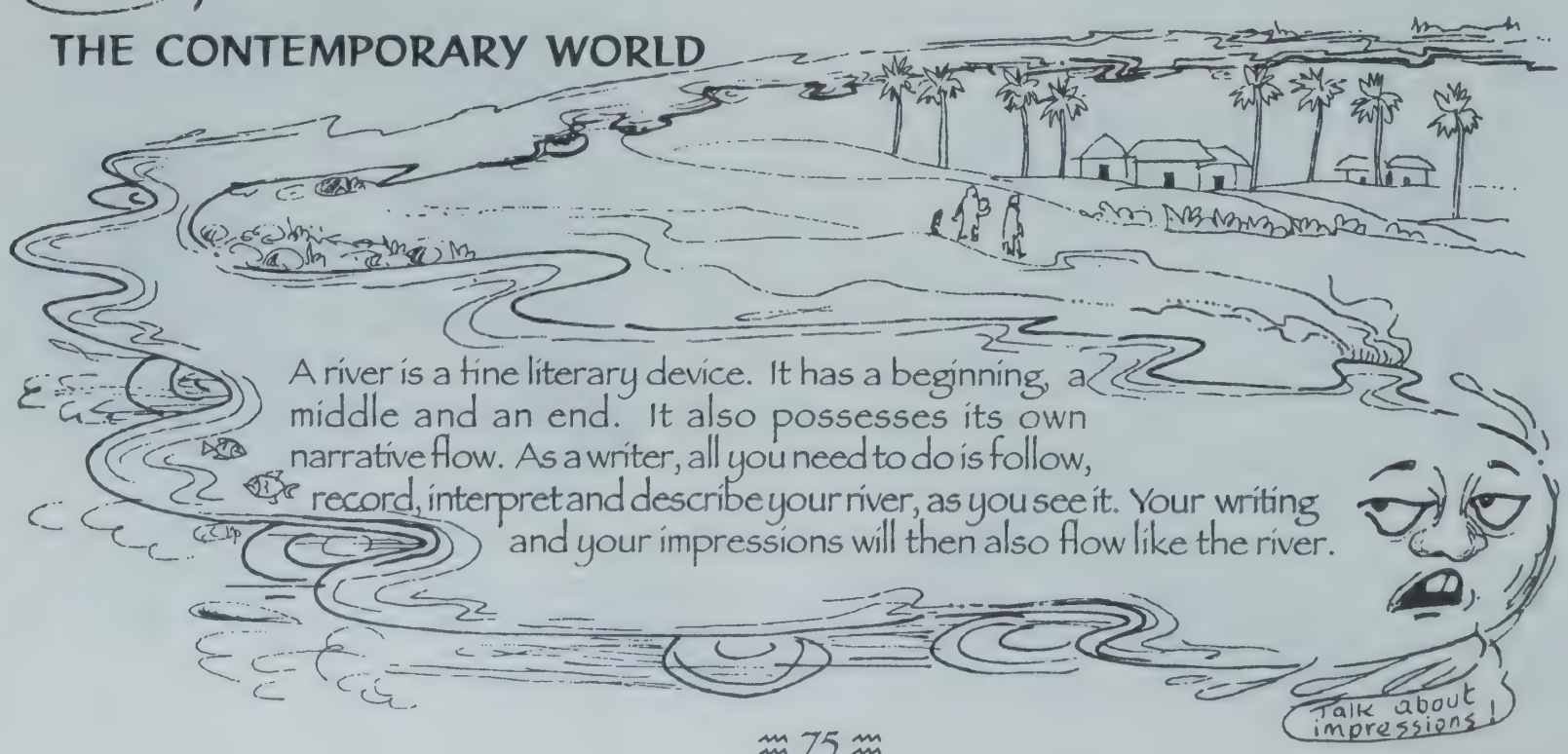
Legends mention that the Krishna river was created from the sweat of Lord Shiva and on the banks of the Godavari sat many sages and rishis who called the river Vriddha-Ganga. The local people still believe that, the waters of these rivers cure many health problems.

Epic stories mention a settlement named Parnasala on the banks of the Godavari; it is believed that Sita was abducted by Ravana from here.

In this river valley are located sites of monasteries and settlements from the time of Buddhism to the history of the 1st and 2nd century BC. the Satavahana dynasty, was also known as the Andhras. Their name 'Andhra' could have been the name given to the lands ruled between the Krishna and the Godavari. This dynasty, though Hindu, offered patronage to the Buddhist order that founded the many monasteries in this river valley and developed them as seats of knowledge.

Activity

THE CONTEMPORARY WORLD


A river is a fine literary device. It has a beginning, a middle and an end. It also possesses its own narrative flow. As a writer, all you need to do is follow, record, interpret and describe your river, as you see it. Your writing and your impressions will then also flow like the river.
Talk about impressions!

At a monastery at Nagarjunakonda, an old inscription mentions that even queens made donations to the Buddhists. These inscriptions give evidence of international relations with areas as far flung as the North West frontiers, Kashmir, Varanasi, Nepal, Orissa, Bengal, Lanka and China. Buddhism flowered in the Krishna and Godavari delta, influencing India's early history, and had international dimensions.

Throughout the last fifteen hundred years, Deccan India has seen a series of strong dynasties who were always in conflict with their neighbours for control over this geographical area, with its abundant natural resources. The black, fertile alluvial soil of lava origin, supports a vast granary of rice, cotton, sugarcane, tobacco and sunflower along with rich mineral resources and fabled diamond reserves. The wealth from this region shaped its history.

Later, Samudra Gupta and Harsha used the lower reaches of the two rivers as main waterways to establish efficient communication with ports built on the eastern coast, that handled trade with South East Asia. After 500 AD and well into modern times, the assimilation of Northern Aryan patterns with Dravidian cultures occurred.

The famous poet and warrior hero Basavanna in the 13th century grew to fame on the banks of the Krishna in North Karnataka. His radical social ideas played an important role in the cultural life here.

This delta region was also the site of some of the earliest European settlements in India. They established factories and trading posts which were fed by river channels. These channels have now largely silted up.

'Standing on the raised bank of the river Godavari at Kaleswaram, overlooking the mile of sand and further stretch of blue water, one was convinced that here at last was the precise meeting place of north and south.'

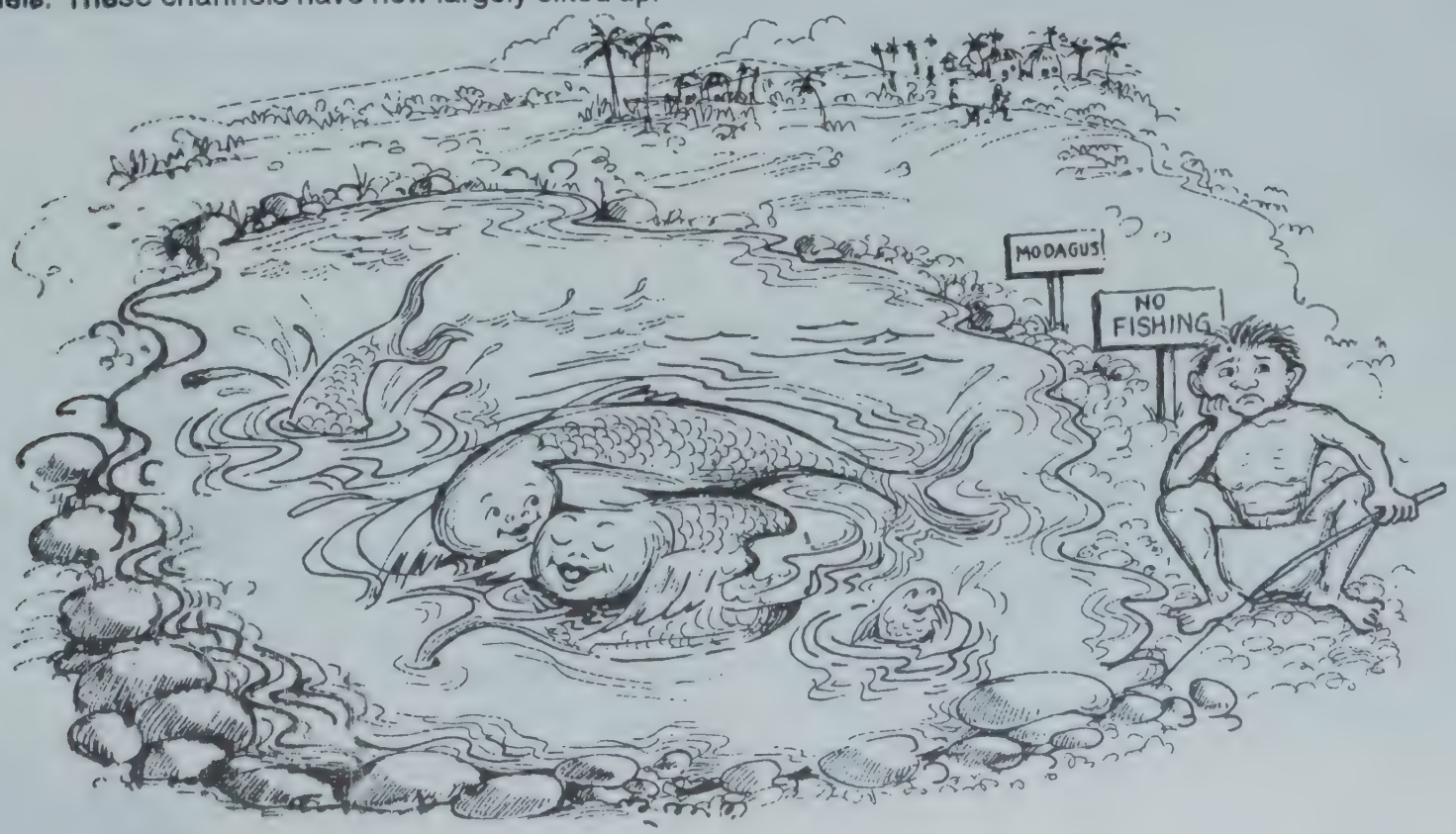
Bill Aitken - 'Seven Sacred Rivers'

• • •

The 'Saptasati' an anthology by Satavahana is a long poem written in the IInd Century. This lyrical collection of folk songs captures village life on the banks of the Godavari. Written in the language of the peasants and sung mostly by women, they revolve around the theme of love. The songs are set in villages with their cattle, buffaloes, ploughing, cooking, milking, weaving and working in rice, sesame, millet, cotton and hemp fields.

• • •

Several big pools called MODAGUS are formed in the summer when there is no flow of water. Big fish settle in the MODAGUS and rest until the next monsoon when the river gets flooded again and then they migrate for spawning. Today, the story is not so natural! During this period of rest, fishermen kill the fish indiscriminately and the breeding fish are not allowed to migrate. Now, many of these MODAGUS have been listed and designated as FISH SANCTUARIES.



myth & culture

"The river runs swift with a song
Breaking through all barriers."

Rabindranath Tagore

Grandmother's stories are famous the world over, and often include myths that express the cultural traditions of the area. Over the centuries, man's fascination for mythical stories has remained strong.

What are **myths**?

Traditional or legendary stories that attempt to explain a basic truth of natural phenomena or events that occured . They are concerned with deities or demi-gods, the creation of the world and the exploits of its inhabitants.

When civilisation began and people started settling down, they began questioning their environment. To explain the happenings of Nature people imagined and created characters and stories. Supernatural elements that could not be understood took the shape of gods. Thus stories got woven around thunder and lightning, day and night, mountains and rivers, forests and deserts etc. Such imaginary wild stories were first passed on by word of mouth.

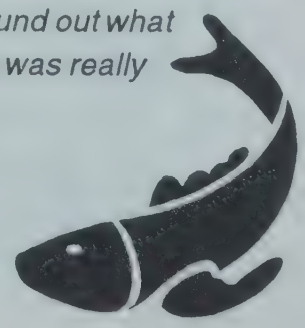
Gradually "Nature Myths" were expanded to include stories of events and folk heroes. Mankind began to express these myths in song, dance, painting, sculpture and later in the written word. These expressions and myths slowly began to provide a base for many rituals and customs, thus becoming a part of the cultural patterns and heritage of people.

The study of myths can be fascinating. Mythical stories around the world have many similarities. From analysing them one can understand the way people have migrated, the inter-mix of races and their settlements. These resulted in many cultural links between human beings despite their being spread all over the world.

The hymns and verses of the Rigveda (approximately 1000 BC) dealing with nature and philosophical thought says "Thou has discovered rivers for the tribes of men"(VI. 61).

Since human beings settled on river banks and began practising agriculture, it was natural that their earliest myths were based on rivers. The rivers came to be worshipped as gods and goddesses as they provided water perennially; water that is so essential for the very existence of human beings.

Here is a charming legend linked with the Sriranga Temple on river Cauvery at Trichy. It is said that Vibhishan, Ravana's brother, on his way back to Lanka after Ram's coronation, was carrying an image of the reclining Narayan(Vishnu). Vibhishan had been warned that if he put the statue down it would take root. As dusk fell, Vibhishan had reached the island of Srirangam, and therefore needed to interrupt his journey to perform 'sandhya pooja' at the confluence of the two arms of the Cauvery. Seeing a cowherd nearby he requested him to hold the statue while he prayed. The boy replied that he would hold it only for five minutes as he was very busy. As Vibhishan did not return in time, the cowherd put down the statue on the rock, where it immediately took root. When Vibhishan returned and found out what had happened, he chased the cowherd up the hill and struck him. As a result the cowherd, who was really Ganesh, never grew. Vibhishan had to leave the statue behind as it had struck root .
The Srirangam Temple stands at this spot.



The world turns softly
Not to spill its lakes and rivers
The water is held in its arms
And the sky is held in the water
What is water, that pours silver,
And can hold the sky?

Hilda Conkling

Activity

A WALKMAN REMEMBERS

On your visits to the river bank of your town, talk to groups of people who have been living there for generations, and also those who make their living from the river. These people will have fascinating stories to tell of the river, stories that will include legends about the temples, and festivals held on its banks. Many songs of the river may still be sung. Record these legends and songs on an audio cassette or as a written piece.

MYTH AND DANCE

Many of the myths of Krishna's exploits have found a place in the dance traditions of India. The Ras-Lila dance of the Krishna myth has found expression in the folk and classical dance traditions in many parts of India. Some of the well-known examples are the Manipuri style of dance of the north east, the Dandiya Ras of Gujarat and the Ras-Lila of Mathura. The last of these has also greatly influenced the Kathak style of dance.

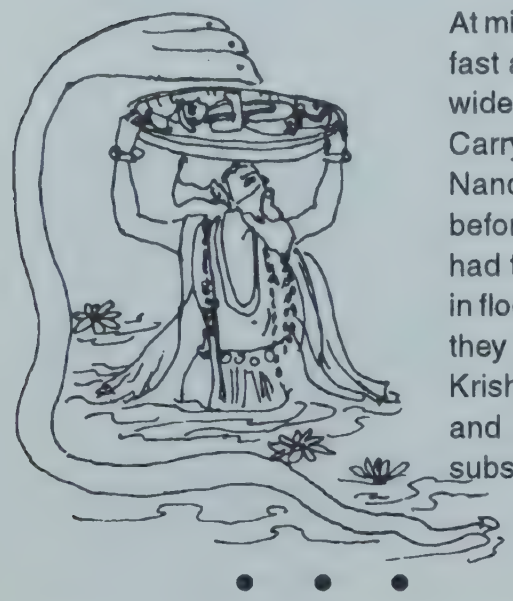
Activity

TRY BEING A JOURNALIST

Write up a review of a concert of music/dance or a folk performance show that is happening in your town. And that is typical of your area. You may also do some homework on the cultural or historical links of the particular event. By including some "background" material you will change the simple reporting to an interesting piece of writing.

MYTH AND ART TRADITIONS

The myths surrounding the exploits and adventures of Lord Krishna are closely connected with the river Yamuna. Many scenes from these myths have been depicted in miniature paintings. These paintings are a distinctive art form and form a priceless part of the cultural heritage of India.



At midnight Krishna was born. The guards were fast asleep and the doors of the prison stood wide open. Vasudev put the baby in a basket. Carrying the baby on his head he fled towards Nand's house. The great serpent Sesha went before him as a guide. On his way Vasudev had to cross the river Yamuna. The river was in flood and the waters kept rising steadily until they nearly submerged him. At this point baby Krishna stretched out his foot from the basket and placed it in the water. The river torrent subsided allowing Vasudev to pass.

• • •

As a young boy Krishna also cleared the countryside of many demons. The serpent Kalia lived in the river Yamuna that ran along the pastures of Gokul. He was a source of great trouble to the herdsmen and cattle. Krishna fought him single handedly underwater. He overcame him and made him leave the river.

• • •

THE RAS LILA : Krishna danced with the gopis on the banks of the river Yamuna at Brindavan. The banks of the river were thickly forested. On moonlit nights, Krishna would play his flute attracting the girls of Gokul. Transforming himself into many images, Krishna danced with each gopi.

MINIATURE PAINTINGS *get their name from the fact that they were painted on small sized paper, approximately 8" by 7" at the maximum. These paintings usually depict mythological stories, religious and cultural themes, court scenes or birds and flowers. Details on these tiny pictures were as perfect as on larger paintings. Every strand of hair, each pearl of a necklace, every petal of a flower was distinctly and skillfully painted. A magnifying glass was used for the extra minute work ! The techniques of miniature painting were passed on within families for generations.*

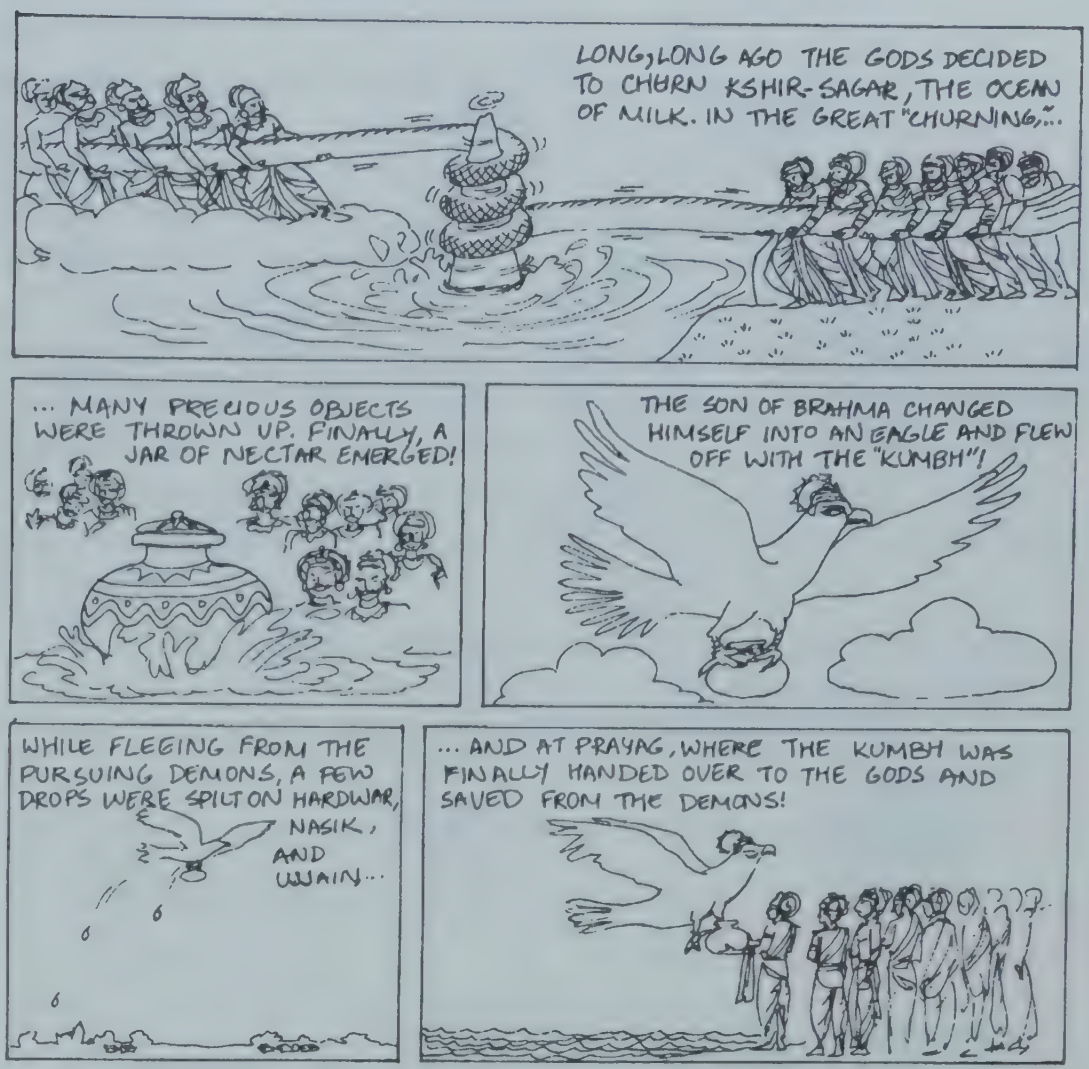
To make a miniature first the paper is painted white on one side. The other side i.e (the back) of the paper is rubbed with a smooth stone till the paper shines! Then the paper is turned over to the right side. The drawing is done in very thin lines using paintbrushes of squirrel hair. The original painters used natural vegetable dyes and colours from crushed and powdered gems and minerals. These paints were traditionally kept in clam shells, that served as a pallette. The paint does not become dry in these containers, and can be used over a long period of time.

Colours made from gold and silver were also very popular. Moghul miniatures had very intricate patterned or floral borders around their paintings.

MYTH & FESTIVALS

One of the oldest festivals celebrated on earth is the Magh Mela. It is held in the month of Magh of the Hindu Vedic calendar that coincides with the period mid-January to mid-February. Bathing in the holy waters of the Sangam in this month is considered auspicious. The religious importance of the Sangam waters where the Yamuna, Ganga and the mythical Saraswati rivers meet at Allahabad (ancient name Prayag) has been emphasized through the ages. Once every twelve years the Magh mela becomes the Kumbh Mela and has an even greater religious significance. Millions of pilgrims participate in the traditional ritual of bathing at the Sangam. The Kumbh mela at Allahabad, is in fact unmatched by any other fair in the world, not only in the sheer number of people who visit the mela, but also those who attach great significance to this festival.

THE WORD "KUMBH" MEANS PITCHER OR JAR AND THE LEGEND CONCERNING THE ORIGIN OF THE KUMBH IS INTERESTING.


LONG, LONG AGO THE GODS DECIDED TO CHURN KSHIR-SAGAR, THE OCEAN OF MILK. IN THE GREAT "CHURNING,"..
... MANY PRECIOUS OBJECTS WERE THROWN UP. FINALLY, A JAR OF NECTAR EMERGED!
THE SON OF BRAHMA CHANGED HIMSELF INTO AN EAGLE AND FLEW OFF WITH THE "KUMBH"!
WHILE FLEEING FROM THE PURSUING DEMONS, A FEW DROPS WERE SPILT ON HARDWAR, NASIK, AND UJJAIN...
... AND AT PRAYAG, WHERE THE KUMBH WAS FINALLY HANDED OVER TO THE GODS AND SAVED FROM THE DEMONS!

Activity

Try Your Hand

Make your own miniature painting. Select a theme related to your river. You can get ideas from the myths that surround it, the monuments on its banks, the flora and fauna, or even from the diverse people who live by the river.

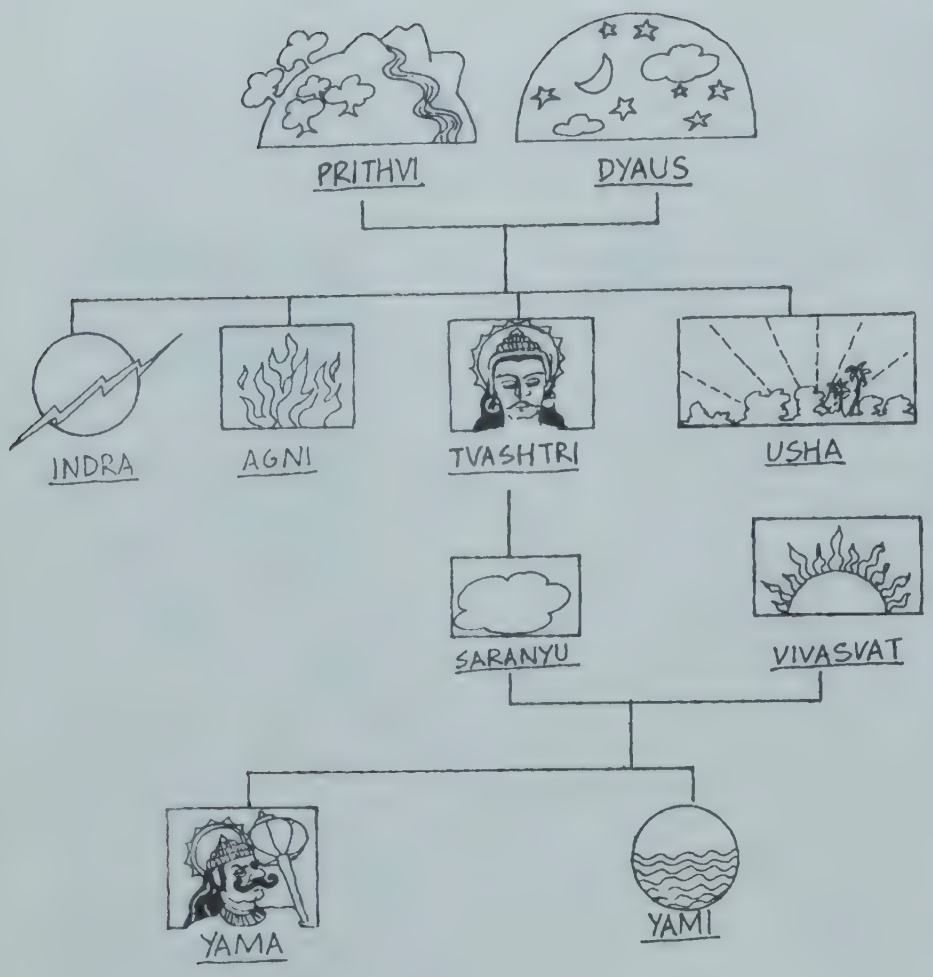
Remember to use a magnifying glass while painting in the finer details! Water colours, vegetable dyes, gold and silver paints can be used with very thin brushes to create your own miniature.

Activity

FESTIVE IMAGES

Choose a festival of your river and follow these steps to create a chart .

Investigate the story behind the event by meeting a variety of people eg. a wrestler from the "akhara"; beggars sitting outside the temple or the widows living on the river bank etc. Photograph the celebrations. Choose an interesting photograph and have this enlarged. Place it on a large drawing sheet. Draw out sketches beyond the edge of the photograph depicting the legendary story behind the event. You may extend the picture with charcoal / pencil / pastel / crayons. If you are not good at drawing, you may make a pen picture, writing around the photograph to illustrate the myth .



MYTH AND LITERATURE

Many popular myths have been incorporated into the writing of literary works such as "epics" all over the world. In India we have the two famous epics of Ramayana and Mahabharat. Even though there are no historical records to prove the existence of Indraprastha, the fabled city of the Mahabharat, it is said that it was located in Delhi. Till today this area is associated in the minds of the people with Indraprastha, as the legends of the epic live on very strongly.

The Mahabharat also mentions a forest area called Khandava - Prastha situated on the right bank of the Yamuna. The war of Kurukshetra was said to be fought over five village areas known as "pats". These still stand today as Tilpat, Sonepat, Inderpat, Panipat and Baghpat.

Delhi's Nigambodh Ghat, a sacred cremation ground that is still in use and the Nilchatri temple on the banks of the Yamuna are believed to have been built by Yuddhistar, the eldest of the five Pandav brothers.

THE MYTH OF THE RIVER YAMUNA

Yami, the Goddess of river Yamuna and her twin brother Yama, the God of Death were the first man and woman on Earth. Yami is worshipped as a Goddess for she waters the seeds (agriculture) that are brought to life also by the warmth and light of her father, the Sun-God. Yami also spells doom like her brother Yama, for when she runs wild, her waters rise in flood.

Yami the Goddess is portrayed as a young maiden standing on a tortoise. This animal is her vehicle. Interestingly many tortoise are found even today all along the banks of the river. She is also portrayed as a river Goddess standing at the doorways of temples to purify devotees.

Activity

CREATE YOUR OWN LITERATURE

Write a story on your own family. Request the eldest member of your family to tell you about an ancestor he/she can remember. Add in incidents or anecdotes that are associated with your family members over several generations. Read out the story to members of your group.

THE STORY OF THE NILE

The Egyptians thought of the Nile as flowing from Nun (the ocean that was present when the world began) which waters all the worlds. The river was worshipped as a God, called Hapi.

Hapi is depicted as a strong, fat man with a massive belly and is dressed like a boatman or a fisherman. He wears a crown of lotus flowers or of papyrus leaves. Hapi is said to have poured water to heaven and earth from his urns. A famous statue shows a reclining god Hapi holding ears of corn and a cornucopia (a horn shaped container full of food i.e. grain and fruits). He is surrounded by 16 children each a cubit high (an ancient measurement unit based on the length of the forearm ; usually about 21 inches). This symbolises the fact that if the Nile waters fell below 16 cubits, the Egyptians would make offerings to Hapi (i.e. the river Nile) to avoid drought and famine.

Such seasonal rituals on the river were of great importance and got connected with the functions of kingship in ancient Egypt. Beautiful hymns were also sung to Hapi.

The story of the Nile was interwoven with the lives of the ancient Egyptians. Their famous solar calendar was based on the annual natural occurrence of the flooding of the Nile. This event served as their time reference.

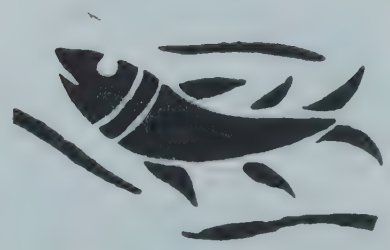
'Hail O Nile, who issues forth from the earth and nourishes Egypt
Who satisfies the desert, who is possessor of fishes,
O Bringer of food
You can make the tree of every watering hole grow'
Hymn to the Nile, New Kingdom.

Activity

CULTURAL CURRENTS

Your river must have many connections with the cultural heritage of your area. Collect all the cultural information on art, dance and literature linked to the myths of your river. You may also find interesting depictions in sculpture, poetry, songs, and even handicrafts....

Make a four page pamphlet that folds out, which you can distribute in your school. Your pamphlet could include text, sketches, cartoons, photographs, quotations and even a map of your river to provide a comprehensive "bird's- eye" view of your river's cultural connection.



PAGES FROM A STUDENTS DIARY

11th December

My grand aunt used to relate many never ending legends to the seven of us: my brother, sister and four of our cousins. Some of these were fascinating myths of the river Yamuna.

We used to visit the ghats with her to celebrate different festivals with a dip in the river. We all lived in an old haveli in the walled city of old Delhi. Once upon a time this was called Shahjehanbad. My grand aunt said that our ancestors settled here during the reign of Aurangzeb.

When the city was new, the havelis looked grand, a water canal ran down the centre of Chandni Chowk and believe it or not, but I was told there were trees in every corner !! There is a lovely miniature painting that my family owns. It shows our lane, the Kinari Bazaar including the front door of our haveli with its huge carved wooden door. I wonder when this door was taken down, for it is no longer there today.

The Kinari Bazaar lane even now sparkles with gold and silver tinsel, coloured beads and bangles. My family still deals in gold and silver threads and the sale of old brocades, as they have since the time of the Mughals.

The elders of our neighbourhood still visit the banks of the Yamuna on festival days.

APPENDIX-1

EVALUATION GUIDELINES

In our formal school system, examinations and evaluations are synonomous with rigidity, fear and rote learning. These ritualistic routines do not stimulate a child's learning or creativity : two factors essential for 'educating' an individual.

Project studies whose subject matter and contents are thought provoking, and whose main aim is sensitising the student, need their own individualistic system of evaluation. The child undertakes a chosen area for detailed study through a dynamic experiential process, that is full of activities along with a lot of challenging and 'fun' reading. It is therefore very difficult to have measurable or quantifiable results at the end.

Yet, a discerning teacher can measure the change in the student's thought processes, levels of participation, an awakened interest in learning, higher levels of motivation, confidence, sensitivity and awareness and last but not least the creativity that has been generated by participating in the 'learning and doing' process of the project.

Observation

The behaviour of group members after a session will indicate a good deal about the way they experienced the learning. After sessions they have enjoyed they are likely to want to stay around and chat; if they have had a negative experience, they are more likely to leave quickly. Whether students talk about sessions afterwards, and in what terms, can also indicate what they got out of it.

There will be many clues in the non-verbal behaviour of the students to evaluate how they feel about sessions. Keenness to get started, bright, expectant expressions, questions about what work will be coming up next time etc., are all likely to indicate that the project is going well.

Apart from the teacher and the students directly involved, there can be additional source of feedback: other staff, other students, and parents of students. They are likely to be in a position to notice changes in behaviour or attitudes in members of the students group, and may be asked to look out for these and give feedback on any development they notice.

By Formal Feedback

Feedback can be gathered systematically after a session by asking all group members to comment upon or write about:

1) What they think they have learned;

2) What they liked about the session;

3) Anything they were not happy with or might want to change.

By informal feedback

Casual comments by group members, other students, other staff, and parents are often very useful indicators. Whether these comments are positive or otherwise will indicate perceptions that are around outside the group itself. There are limitations to this kind of feedback, because it will be expressed in terms of feelings, impressions or reactions of people who have not been involved in the experience themselves.

By Testing

If one wishes to assess whether knowledge has been imparted or skills developed, then this may be checked by testing in some form or another if that is appropriate. Knowledge gained may be measured by oral or written test or by inviting some form of presentation by the learner.

A very useful test of what has been learnt can be to invite the learner to teach somebody else. Having to pass on certain knowledge, or teach a skill one has acquired, is likely to be an excellent test of what one has grasped.

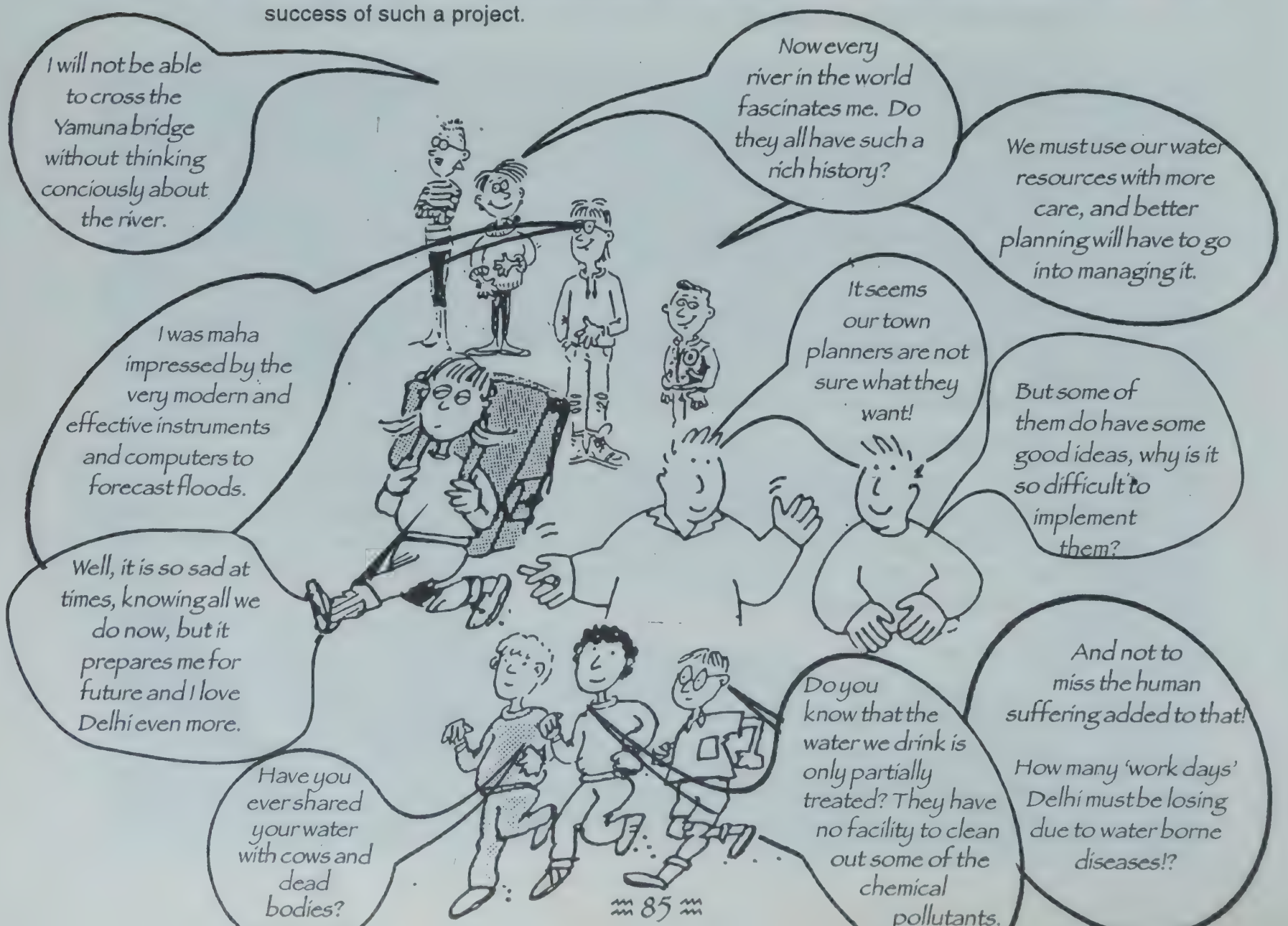
Evaluating In Stages

Evaluation carried out very soon after an educational event will have all the advantages of feedback that comes fresh from the experience, when those involved will be able to use their immediate feelings, thoughts, reactions, impressions, etc. It will also have some possible limitations simply because it is so instant. Fresh from an experience, students and teacher may have views and make responses that will subsequently evolve or change. Sometimes participants are 'too close' to an experience fully to assess its value. Immediate impressions have their worth; so does feedback given after participants have had longer to reflect, assess, practise, and test the significance of that experience. Evaluation procedures therefore should take into consideration feedback and assessment data collected at different stages after the event.

Once evaluation has been carried out, the finding may be of interest to others, e.g. the students, colleagues, principal or parents. Remember: positive results will obviously be very reinforcing for all involved and the work will therefore gain credibility.

Our own experience has shown that students have a remarkable positive change in their attitudes and in their learning abilities. Being active participants in planning and conducting 'their' project gives them a sense of ownership, and inculcates a desire for success. In designing activities, best suited to themselves, as well as by presenting their data in a medium also of their choice greatly enhances their interest, confidence and creativity.

Another factor that gets automatically evaluated during the programme is the increase in the students concern, awareness, and sensitivity to the subject matter/issue of the programmes and therefore to the people connected with the same. In this particular area of study, the Riverfront of My Town, the students concern for people living on the river bank, for the gross abuse of the river itself by all concerned, and the alienation of the towns people to their river, came through in everything they did. Ultimately, even when the project was completed, the students went in search of other rivers to study them. Creating a critical curiosity in the student was probably the ultimate barometer of the success of such a project.


I will not be able to cross the Yamuna bridge without thinking conciously about the river.
Now every river in the world fascinates me. Do they all have such a rich history?
We must use our water resources with more care, and better planning will have to go into managing it.
I was maha impressed by the very modern and effective instruments and computers to forecast floods.
It seems our town planners are not sure what they want!
But some of them do have some good ideas, why is it so difficult to implement them?
Well, it is so sad at times, knowing all we do now, but it prepares me for future and I love Delhi even more.
Have you ever shared your water with cows and dead bodies?
Do you know that the water we drink is only partially treated? They have no facility to clean out some of the chemical pollutants.
And not to miss the human suffering added to that!
How many 'work days' Delhi must be losing due to water borne diseases!?

APPENDIX - 2

THE GANGA

"As the snow melts and rain runs off the land, it collects in streams and rivers. Cascading down mountains and into the plains on its long journey back to the sea....."

Thus the Ganga, begins in an ice-cave 4000 metres up in the Himalayas, to form the most holy river on earth — the Ganges.

The Ganga has seen many civilisations come and go, she encompasses various cultures and symbolises the overlapping layers of Indian heritage. Considered a mother Goddess in the pantheon of Hindu divinities, the Ganga occupies a unique position of sacred and ritualistic worship, where she is meant to cleanse, purify and sanctify all with her waters.

Elaborate hymns, literature and myths have been inspired by this river. The fertile Gangetic lands have lured mankind from time immemorial, thereby forming the cradle of Indian civilisation. Even the great Moghul Akbar called the river "the source of all life because of its water of immortality"(from the official chronicler Abul Fazl).

Melting glacier snow is the perennial source of the river Ganges. The river rises near Gangotri in the Himalayan region of Uttar Pradesh and flows for 2506 kms before it empties itself into the Bay of Bengal. The Ganga flows through lush pine forests, snaking through the valleys and gorges in the hills. It then flows through the northern states of Uttar Pradesh, Bihar and West Bengal in India before entering Bangladesh. It is interesting how the river changes its name as it flows along. In the Himalyas the river is called Bhagirathi and becomes Ganga only after joining the Alaknanda at Dev Prayag. Near Dhaka, in Bangladesh, after meeting the mighty eastern river, Brahmaputra, the river is now called Padma and as such flows into the delta along with the Hooghly distributary. The Sagar Island considered auspicious, sits on the mouth of the Hooghly where the Ganga merges with the ocean.Ganga waters are enhanced by many famous tributaries, thereby forming a major river system in the world. In Bangladesh the rich alluvial delta of the river covers an area of approximately 57,000 square kms and forms one of the most unique eco-systems and fertile lands of the world. Today hundreds of millions inhabit the Ganges basin. Here people have always depended on its fertile alluvial soils, the rich potential of its fisheries and the ready access to a perrenial source of water. The 20th century has seen the mushrooming of industrial towns along the banks of the river. Hordes of people and large industries use the waters of the Ganges for all their needs and each city, town, person and factory adds their waste products to the Ganga.

Rivers have always been symbols of man's travels and communications. From rafts to country sailboats to steamers to tyres! They have all traversed the Ganga waters. The river Hooghly (one of Ganga's main distributaries near the delta) has seen a fascinating mix of boats and larger ships that sailed into the towns at high tide, and serviced the European settlements on its banks for centuries. The boats have plied on the river on the Uttar Pradesh and Bihar stretches. A fascinating 'watching the world go by' activity (see pg.60) is today being denied to many people for sadly the water levels are going down and so is the plying of boats. Today we see there is a great loss of association with the river for the contemporary man.

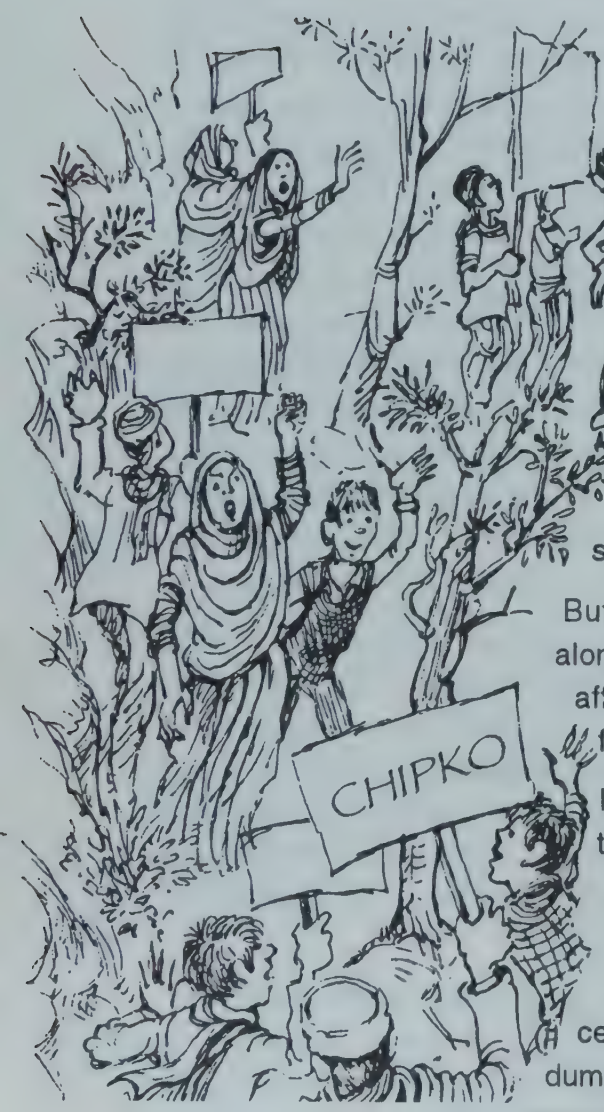
It is interesting to know that until the 14th century, the entire Ganges plain was covered in forests! Tigers roamed the plains instead of people. It was Feroze Shah Tughlaq who began to clear the forests and dig a network of canals, starting the process of making the Gangetic plain the granary of Northern India. Much later, engineers of the British Indian Government rebuilt most of these canals, besides adding others to the rivers Ganges and Yamuna.

From the 1820's when the British set about restoring these canals, they were learning and documenting ancient indigenous skills in irrigation. It was here that British engineers learnt all about successful irrigation and in the process they laid the foundations of hydraulic engineering. In 1854, the largest canal system was opened: the Ganga canals, that irrigated lands about 100 kms wide between the Ganges and Yamuna river. The criss-cross of waterways adding upto a total of 1300 kilometres were built by coolies carrying soil in baskets on their heads.

These canals were supposed to prevent a recurrence of famine, but in practise they played havoc with natural drainage. They overflowed and created water logging that cut off natural gulleys that had carried away monsoon rains. Within twenty years, the fields became quagmires, and where the canals went, malaria followed. Many sacrifices were justified in order to create a granary which would provide instant tax revenues.

On a train journey from Delhi to Calcutta today, the passenger passes over the iron girders of many bridges, that span not only the Ganga but practically all its great tributaries, and its distributary: the Hooghly. At Varanasi and Allahabad one is aware of the close contact with the Ganges even from the train. The 800 kms between Allahabad and Calcutta, where the Ganga flows, slowly and majestically, has been captured in words, water colour paintings and photographs by scores of travellers over the years. The aquatints of Thomas and William Daniell in the 19th century capture the luminous water of the river and its landscapes with great skill. And, of course, Jawaharlal Nehru has written very poetically about the river.

"The Ganga, especially, is the river of India, beloved of her people, round which are interwined her memories, her hopes and fears, her songs of triumph, her victories and defeats, she has been a symbol of India's age long culture and civilisation, ever changing, ever flowing and yet ever the same Ganga ."



Many rivers of India including the Ganga have been systematically betrayed. The trees that guaranteed the river waters their life, have been destroyed along with development projects that have laid waste the banks. The dwellers of these forests have been seen sold down the river, their lands ravaged by floods. The upper reaches of the Ganga, where its name is still Alaknanda, saw the remarkable defiance of the people who understood the implications of deforestation. It was their desire to protect their deodars from the axe of the timber merchants that gave birth to the Chipko movement. They clung to their trees saying 'Save the trees and you'll save the water'. This small beginning on the banks of the Ganga(Alaknanda) saw the Chipko strategy become a national concern to save trees by direct action.

But sadly fertilisers and pesticides introduced into intensively cultivated farmlands alongside the river, create unseen damage that comes from agricultural run-offs, and affect the river and river life. The chemicals poison not only the water but also the flora and fauna, thereby changing the environment forever.

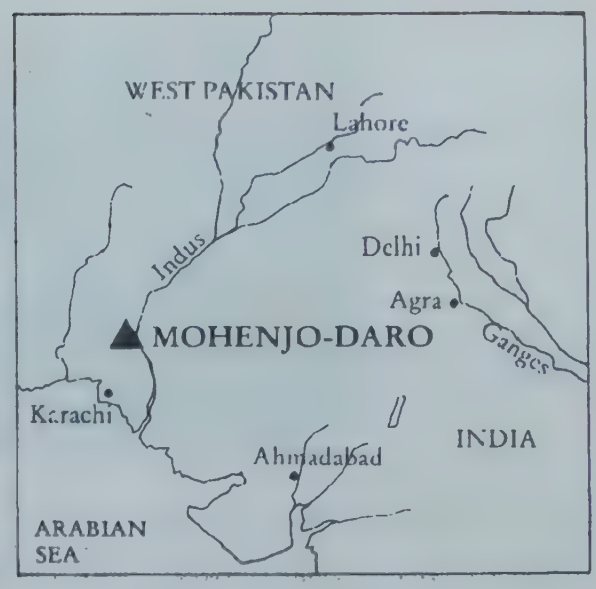
In addition, none of the 112 towns and cities along the Ganga has full sewage treatment facilities. Untreated sewage, domestic garbage, industrial effluents, carcasses of animals and half-burnt human corpses thrown into the water grossly pollute the river.

This uncaring attitude has turned whole stretches of the river into stinking cesspools and black waters. We continue to use the river as a "running rubbish dump."The 20th century has therefore seen this great river dammed and polluted in the name of progress. No wonder the cost in environment damage and ill health is even greater. We wish the Ganga Action Plan of the Government - all the very best!

You can imagine the magnitude of the problem! And, what a monumental task to save not only our country's main river, but also to safeguard an ancient cultural heritage.

APPENDIX - 3

THE INDUS



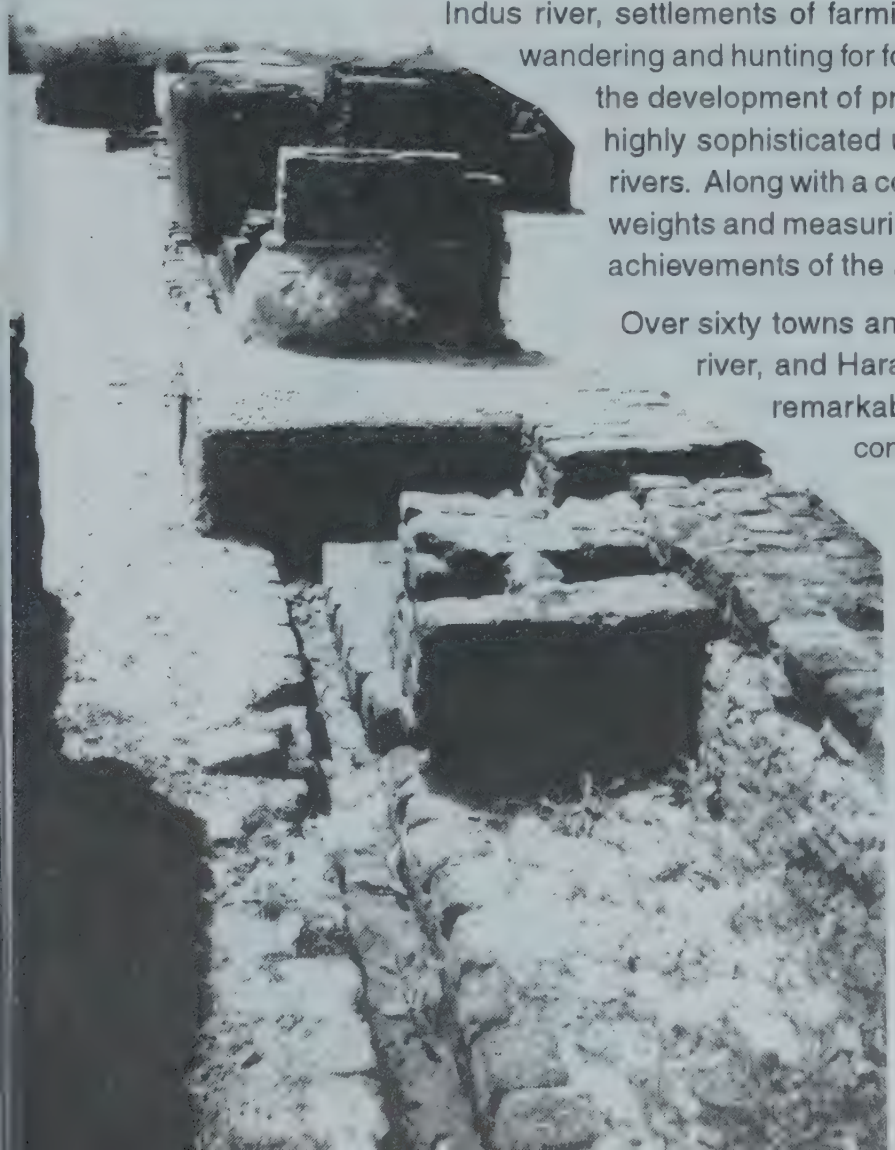
In the north west of the Indian sub-continent runs a great river, the Indus. In fact our country gets its name from the Indus river. These mighty roaring waters attracted ancient man to settle on the banks, and establish a river valley civilisation six thousand years ago.

The other name of the Indus river is the Sindhu. As times changed it was generally thought by outsiders that people who lived on the other side of this great river were Hindu - from the word Sindhu (The Indian name for the river Indus). As the Hindus started developing a strong philosophical and spiritual thought process, and gradually over time this 'religion' of the Hindus came to be known as 'Hinduism'. The Indus river has therefore a very deep and synonymous association with the historical evolution of India and her people.

The Indus runs a course of 1800 miles from the snow-bound glaciers of the Himalayas to the waters of the Arabian Sea. The Indus river system is one of the largest in the world, encompassing several tributaries, irrigating and supporting a very large agrarian economy and with a wide and rich delta.

The Indus rises from near Lake Mansarovar in Tibet in the great Himalayas, flows through high mountainous ranges into Ladakh (an elevated plateau with sparse cultivation), and enters Pakistan, south west of Gilgit. In north-west Pakistan the Indus is joined by the rivers Kabul and Kurram. As it enters the fertile lands of the Punjab plains it is joined by the famous five rivers from India : Jhelum, Chenab, Ravi, Beas and Sutlej (see map). We all know that PUNJ(five) and AAB(water) is the meaning of the name for this ancient land from time immemorial.

The Indus basin not only contains one of the world's largest irrigated areas but also the beginnings of one of man's earliest civilisations. As far back as 4000 BC, there appeared on the banks of the Indus river, settlements of farming communities. It was during this time that nomadic man wandering and hunting for food, turned to land and agriculture. This soon transformed into the development of primitive village cultures. By 3000 - 2500 BC a well organised, highly sophisticated urban culture and civilisation existed in the land of the many rivers. Along with a complex urban culture, writing, craftsmanship, arts, architecture, weights and measuring systems, agriculture and animal husbandry were the major achievements of the Indus Valley Civilisation.



Over sixty towns and villages and two major cities of Mohenjodaro on the Indus river, and Harappa on the Ravi river were located here. The cities show a remarkable sophistication in their layout and planning. They were constructed in one mile squares, with well laid out roads and houses built of kiln fired bricks. Five thousand years ago the houses of this river civilisation had indoor baths and toilets with paved floors! The bathrooms were connected to a system of drains, and water chutes to sewers running beneath the main streets. Craftsmen worked with bronze and precious metals and potters used the wheel. Beautiful figurines and vessels, made of metal and terracotta are famous as examples of Indian heritage the world over.

Specialising in trade, the Indus valley civilisation gave birth to a merchant class whose commercial activities extended to the Persian Gulf, and to the cities of the Mesopotamian and Sumerian Civilisations.

Thousands of exquisitely carved seals of metal and soap stone with figures of animals have been found all over these lands. They could have been used for identifying, making and sealing bales and bags of produce.

After a span of a thousand years, by about 1500 BC, the Indus Valley Civilisation showed a slow decline near Mohenjodaro and a baffling sudden stop at Harappa. Most archeologists agree that there can be no simple explanation for the complete disappearance of the Indus Valley Civilisation.

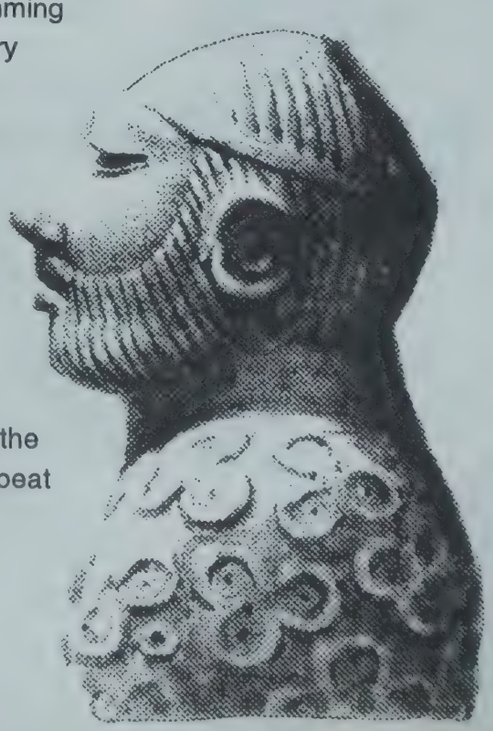
From 1500 BC to modern times, invaders, settlements and kingdoms have flourished and died on the banks of the Indus and its five tributaries. It was from the port towns of the Indus delta that Arab dhows plied, laden with merchandise for distant markets. Trade with the western world through ports on the Indus, resulted in a growing interest in India among Europeans.

The flat tracts of rich fertile lands located between the five tributaries are called 'the doab'. The plains are irrigable and cultivable, and the Indus Basin contains one of the world's largest irrigated areas. Earlier irrigation was mainly through flood waters and indigenous canals that led flood waters to areas away from the river banks.

From the middle of the 19th century, the British government in India constructed a series of large canals systems that joined the lands with the river; thus the doab lands started receiving perennial irrigation. All these canals were based on the natural flow of the river. No storage dams or reserviors were built at that time. In 1947, the Indus basin represented the largest irrigated area (26 million acres) compared to any other river system in the world. This has been made possible by the natural physical geography of the area.

In the early 20th century Punjab canal colonies sprung up and by the 1930's barrages started to be developed for water storage. Plans were made for many more, which got built in the post-independance era, in what is now Pakistan.

The environmental crisis began in 1932 with the construction of the Sukkar barrage, as fresh water disappeared for four months of the year into the reservoir. With four to six major barrages coming up on the Indus in Pakistan, nearly 74% of the waters of the Indus river system was captured before the river reached the delta region. Starved of fresh water and no longer able to hold back the encroaching Arabian Sea, the Indus delta channels are today becoming dry, and the salt is destroying the lush mangroves and arable lands. From an area of 3000 square kms the delta has today shrunk to 250 square kms! Old towns humming with commercial activity till the first decades of our country are today ghost towns; pasture lands are barren and there is no silt in the river waters to stabilise a coastline. Besides this, the coastal mangrove ecosystems have been endangered along with a number of marine species. These ecological changes along with a scarcity of water, has had an impact on the social life of the communities living along the southern regions of the Indus. Eventually with the Indus delta dying a slow death, there will be direct consequences to the upper streams of this great river system, and then may be a slow decline similar to that of the ancient Indus Valley Civilisation. Will history in this way repeat itself? Who knows?



GLOSSARY

Ablution	Cleaning hands or body with water or other liquid especially as a religious or ceremonial ritual.
Acid	A chemical substance that contains hydrogen and neutralises the alkalis.
Aerobes	An organism, esp., a bacterium that requires air or free oxygen for its life.
Algae	Non-flowering stemless water-plant.
Alluvial	Deposit of earth, sand etc., left by flood or flow of water.
Anaerobes	An organism, esp., a bacterium that does not require air or free oxygen to live.
Animism	To believe that natural objects and phenomena possess a soul.
Apex	Highest point.
Aqueduct	Channel for conveying water especially if installed in a tall bridge across a valley.
Arboreal	Of or living in trees. e.g. monkeys.
Archaeology	The study of ancient peoples and places esp., by scientific excavation of physical remains.
Archetypical	Original model, prototype.
Bleaches	Chemicals that contain chloride of lime and having a characteristic odour. Articles dipped in this compound acquire a paleness or become white.
Buffer	Thing that softens an impact.
Calligraphy	Beautiful handwriting or fine, fancy decorative penmanship.
Carnivorous	Flesh eating.
Catchment	Collection of rainfall.
Coliform	A bacteria that is found in the large intestines of man and animal. The presence of this in water indicates fecal(sewage) pollution.
Coniferous trees	Trees that bear cones. They are evergreen and thrive in temperate zones.
Conserving	Keep from harm, decay or loss.
Deciduous	Trees that shed their leaves annually in a particular season.
Defiles	Make dirty; to pollute.
Deforestation	To cut forest and trees.
Delta	A flat plain of new land made up of mud and sand carried by a river, often triangular in shape and situated where the river meets the sea.
Ecology	Study of organisms in relation to one another and to their surroundings.
Ecosystem	A system formed by the interaction of a community of living things with their environment.
Effluent	Something that flows out. (normally from a factory or an industry)
Embankment	A raised bank made from earth or stone to hold back water.
Epidemic	A rapid spread of a disease among a community at a particular time.
Erosion	The process by which the surface of the earth is worn away by the action of water, glaciers, wind, sea etc.
Estuary	Wide mouth of river where it meets the sea. The water in an estuary is a mix of fresh water and sea water
Evergreen	Trees that retain green leaves throughout year.

Geology	Science that deals with the physical history of the earth's crust and rocks along with the changes that keep occuring.
Germinate	To sprout or begin to grow from a seed/shoot.
Glacier	A large mass of ice formed by falling snow that has accumulated over the years and moves very slowly, often coming down from high mountains.
Gorges	Narrow and steep openings between hills.
Gunwale	Upper edge of a boat's side.
Herbivores	Animals that feed on plants.
Impermeable	Substances, usually rocks that do not allow the passage of liquid/water.
Lugubrious	Mournful, dismal, gloomy in an exaggerated manner.
Meanders	The winding or indirect course of a river.
Navigable	Deep and wide enough to afford passage to ships.
Nemesis	An act of punishment that is perceived as justice.
Nutrient	Providing nourishment in the form of food.
Omnivores	Feeding on both plants and animals.
Parasites	Animal or plant living in or on another.
Percolates	Filter or ooze through
Plunge pool	A pool of water created by a waterfall falling into it from a height.
Pollution	Make foul or impure.
Primeval	Of the first age of the world, ancient.
Propagate	To reproduce from parent stock.
Rapids	Water flows over a steep descent in the river-bed, with a swift current.
Saline	Containing salt.
Sediment	Matter carried by water and deposited on the surface of land.
Silt	Sediment deposited by water.
Smelting	Extract or separate a metal from an ore by melting.
Solvent	Able to dissolve or form a solution with something.
Temperate	Mild or moderate in reference to temperature.
Tributaries	River or stream flowing into a large river or lake
Velocity	The rate of speed or motion especially in a given direction.

EXTRA READINGS

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14 Anupam Mishra, *Rajasthan ki Rajat Boondein* and *Aaj Bhi Khare Hain Talab*, New Delhi : Gandhi Peace Foundation, 1994.

15 Ramachandra Guha and Madhav Gadgil, *Ecology and Equity*, Penguin Books (India) Pvt. Ltd., 1995.

Some organisations that deal with environmental awareness and can give support to schools:

- Centre for Environment Education, Thaltej Tekra, Ahmedabad and all Regional cells.
- Centre for Environment Education, Regional Cell (Southern Region)
- Centre for Science and Environment, 41, Tughlakabad Institutional Area, New Delhi - 110 062.
- Kalpavriksh, New Delhi.
- Creative Learning for Change, S-286, Greater Kailash-II, New Delhi-110 048.
- World Wide Fund for Nature, Head Office, Max Muelier Marg, Lodi Estate, New Delhi - 110 003. (And all regional offices of the World Wide Fund for Nature).

CENTRE FOR ENVIRONMENT EDUCATION

CEE is a national institution established in 1984 and supported by the Ministry of Environment and Forest, Goverment of India, under the scheme of promoting "centres of excellence". The central office is located at Ahmedabad. Through various educational and action programmes, CEE aims at creating environmental awareness among children, youth and the general community. The areas of CEE's activities include environmental education in schools, training, eco-development, media, interpretation, experiencing nature and urban programmes

To facilitate the effective co-ordination, monitoring and follow-up of environmental education programme across the country in a decentralised manner, the Centre has set up Regional Cells in different zones of the country. CEE South, functions from Bangalore ; CEE NorthEast functions from Guwahati ; CEE North functions from Lucknow; CEE Central functions from Pune and CEE West from Ahmedabad. There is a small office set up at Delhi for some co-ordination in the capital.

Centre for Environment Education (CEE) is constantly designing and participating in many educational strategies in the wide field of environment.

CEE has been in the forefront in creating awareness regarding the degrading environmental condition of our rivers, that are one of the richest natural resources our country possesses. CEE has linked this concern with the educational fraternity and the Government of India through being an active member in the programming of the educational component of the Ganga Action Plan.

This programme involved approximately 100 schools located along the Ganga. Here the students carried out water quality monitoring activities, applying scientific knowledge and experimental techniques learnt in the school's classrooms to real life situations in their own vicinity. CEE facilitates such projects by developing monitoring kits, along with instructional materials and information for use by students. Workshops and orientation programmes were conducted by CEE for the teachers and education administrators who participated in this programme.

Testing water quality through using simple kits is one of the ways to make people aware about the importance of water and the quality of water needed for human consumption.

The project was well received and CEE received accolades for designing a programme with clearly defined educational values and a strong potential for creating an awareness about the need for pollution control. CEE is now developing appropriate action plans for replicating such environmental education programmes for other river systems elsewhere in the country.

CLC

CREATIVE LEARNING FOR CHANGE

The varied issues that confront us as a developing society present challenging possibilities for the creation of innovative educational materials. Creative Learning for Change is a non-governmental organisation that transforms field based data and real life experiences into publications and documentation, workshops and training programmes, audio visuals and other educational materials. CLC also carries out research projects and designs educational strategies that critically reflect the surrounding reality. Its trustees are well-known in the NGO and development sector and its working group is a team of experienced development educationists. CLC works actively in the following four educational fields.

ENVIRONMENTAL EDUCATION

To address the paucity of materials in this area and to motivate young people to become active agents of change CLC adopts a multi-pronged strategy. From writing fictional stories based on actual case studies to conducting workshops and hands-on learning projects for teachers and students on ecological issues to devising stimulating project based activity books, slide shows and video programmes, CLC constructively addresses the key concerns of today and tomorrow.

NON-FORMAL EDUCATION

Creating reading materials relevant to the neo-literate and providing training inputs that include teaching methodologies and curriculum design to NFE workers are some of the ways in which CLC actively explores new and innovative ways of tackling the problems of illiteracy. In addition CLC has carried out extensive research on major governmental initiatives in this area.

FORMAL SCHOOL PROGRAMME

After a detailed study of alternative school systems across India, CLC is helping various NGO's establish formal schools in their areas. The aim is to create a pedagogy that will foster a creative and holistic learning process that will sensitize the child to, rather than alienate her, from her own culture and environment. CLC has also created a sample of an alternative curriculum for class VIII, and participates in planning workshops at NCERT. Many schools across India have interacted with CLC to design learning programmes for their students.

WOMEN'S ISSUES & GENDER SENSITIVITY

Challenging the existing stereotypes and questioning traditional role models of men and women is the major thrust of our work in this area. This includes empowering women through the sensitive portrayal of the lives of pavement dwellers, deserted women and women leaders through scripts and stories. Further, designing gender sensitive educational capsules that can be used in colleges, schools, management courses and other institutions. A recent addition to our work is designing and conducting training courses on HIV/AIDS and Development at local, state and national levels.

Publications by Team Members of CLC

- **REACHING OUT**

A set of two manuals for students and teachers involved in the National Literacy Mission. Published by the Ministry of Education, translated into Hindi Marathi, Telegu and Kannada. English edition (set of two books) available for Rs. 20/- a set.

- **EXPLORING AN ENVIRONMENT**

Discovering an urban reality. A project cym activity manual for students and teachers Published by INTACH and Ankur. First edition sold out. Photostat copies Rs 50/-

- **NAINA'S VILLAGE** - **CHIPKO** - **THE RAINDROP** - **WITHIN THE WELL**

Children's stories for the age group 10-14 based on actual environmental case studies. Published by Centre for Science and Environment. Each title Rs. 20/-

- **MEN, WOMEN AND SOCIETY**

A multi-media gender capsule prepared for the Indian Navy as part of their training programme for sailors and cadets. Unpublished and classified.

- **THE DANGER WITHIN**

An activity book on Occupational Health Hazards specially designed for use by schools and individuals, Published by Society for Participatory Research in Asia (PRIA).Rs. 100/-

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Shikshamitra
EDUCATION RESOURCE CENTRE
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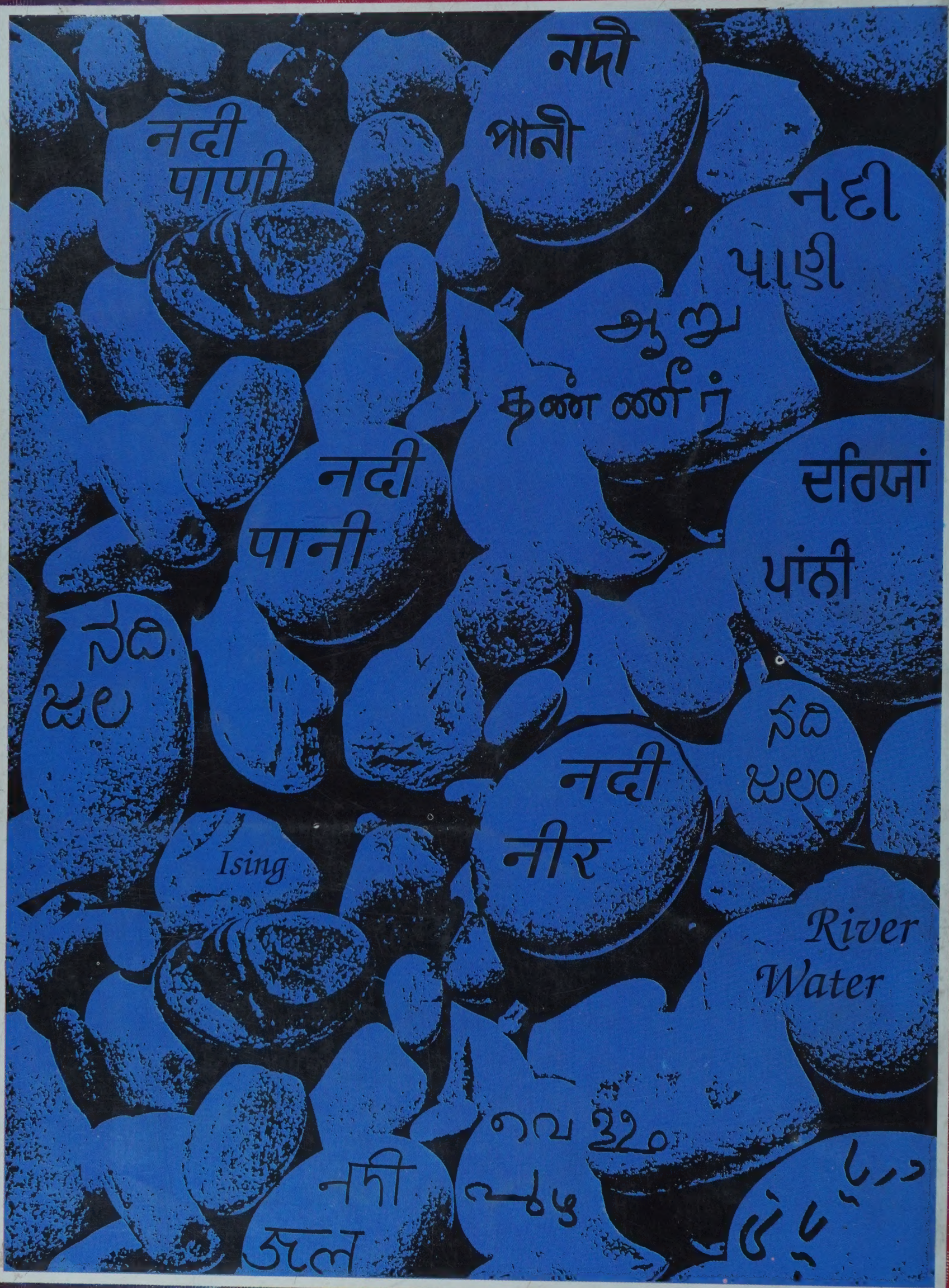
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